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AUTHORIZING APPROPRIATIONS TO THE NATIONAL BUREAU OF STANDARDS FOR FISCAL YEARS 1984 AND 1985

APRIL 4, 1984.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

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Mr. FUQUA, from the Committee on Science and Technology, submitted the following

REPORT

together with

MINORITY VIEWS

[To accompany H.R. 5172]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science and Technology, to whom was referred the bill (H.R. 5172) to authorize appropriations for activities of the National Bureau of Standards, and for other purposes, having considered the same, report favorably thereon with amendments and recommend that the bill as amended do pass.

The amendments are as follows:

Page 4, line 6: delete "3,752,000" and insert "3,625,000".

Page 11, line 17: strike ", or" and insert a period; and

Page 11, lines 18 to 24: delete Subsection 304(2).

PURPOSE OF THE BILL

The purpose of the bill is to authorize appropriations for fiscal years 1984 and 1985 to the National Bureau of Standards and related activities out of money in the Treasury not otherwise appropriated, as shown in the following table:

TITLE I—FISCAL YEAR 1984

	Authorization fiscal year 1984
National Bureau of Standards:	
Measurement research and standards	$50,166,000
Engineering measurements and standards	21,276,000

H7036

	Authorization fiscal year 1984
Computer science and technology	10,000,000
Core research program for innovation and productivity	12,053,000
Technical competence fund	8,169,000
Fire research center	5,827,000
Central technical support	8,227,000
Subtotal, NBS	115,718,000
Excess Foreign Currency, NBS	700,000
Office of Productivity, Technology, and Innovation	3,625,000
Total, Title I	120,043,000

TITLE II—FISCAL YEAR 1985

National Bureau of Standards:	*Authorization fiscal year 1985*
Measurement research and standards	$57,948,000
Engineering measurements and standards	23,194,000
Computer science and technology	10,000,000
Core research program for innovation and productivity	12,168,000
Technical competence fund	8,598,000
Fire research center	5,827,000
Central technical support	15,065,000
Subtotal, NBS	132,800,000
Excess Foreign Currency, NBS	600,000
Office of Productivity, Technology, and Innovation	4,121,000
Metric Evaluation Act	500,000
Total, Title II	138,021,000

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1. SUMMARY OF COMMITTEE ACTIONS

Committee Budget Actions

The following Committee actions are reflected in the Bill H.R. 5172.

TITLE I—AUTHORIZATION FOR PROGRAM ACTIVITIES, FISCAL YEAR 1984

Title I would authorize the programs of the National Bureau of Standards and the Office of Productivity, Technology and Innovation for fiscal year 1984.

The authorization legislation, H.R. 2513, for the NBS for fiscal year 1984 was reported by the Committee on Science and Technology on May 9, 1984 (House Report 98–95). However, that bill was not acted upon by the House.

The content of Title I is described briefly below. For a detailed description of the fiscal year 1984 programs and budget reference is made to House Report 98–95.

RECENT CONGRESSIONAL ACTION

As reported by the Committee on Science and Technology in May 1983, the bill H.R. 2513 would have authorized a total of $125.5 million for the NBS. Since that time, the appropriations law has provided $115.7 million. The sums for the individual line item categories have consequently been adjusted so that each category as well as the total reflect the levels of the Appropriations Act, Public Law 98–166.

MEASUREMENT RESEARCH AND STANDARDS

For this activity, which involves research and development associated with the maintenance of the nation's basic standards of measurement in all fields, the bill would authorize the sum of $50,166,000.

ENGINEERING MEASUREMENTS AND STANDARDS

For the engineering measurement activities, which covers the practical applications of a broad range of measurement activities throughout the national economy, the sum of $21,276,000 would be authorized.

COMPUTER SCIENCE AND TECHNOLOGY

For the development of computer and network standards and related computer research and development, the bill would authorize the sum of $10,000,000.

CORE RESEARCH PROGRAM FOR INNOVATION AND PRODUCTIVITY

In this category of activities are assembled a number of research and development activities in such fields as materials, robotics, manufacturing, and integrated circuits which contribute directly to the enhancement of national technology innovation and productivity, and for which $12,053,000 would be authorized.

TECHNICAL COMPETENCE FUND

The Technical Competence Fund enables the Bureau to conduct advanced research and development aimed at maintaining the ability of the scientific staff to anticipate and respond to emerging

technological needs in the Nation's industries. The sum of $8,169,000 would be authorized for this activity.

FIRE RESEARCH CENTER

The fire research program is aimed at reducing the serious losses in lives and property sustained throughout the country as a result of fires. The sum of $5,827,000 would be authorized for this vital research program.

CENTRAL TECHNICAL SUPPORT

For the central technical support activities needed for the conduct of NBS's work, the sum of $8,227,000 would be authorized.

OFFICE OF PRODUCTIVITY, TECHNOLOGY AND INNOVATION

The bill would authorize $3,625,000 for the Office of Productivity, Technology and Innovation to continue the development of policies and cooperative activities between government and industry aimed at the enhancement of technological innovation and industrial productivity.

TITLE II—AUTHORIZATION FOR PROGRAM ACTIVITIES, FISCAL YEAR 1985

Title II would authorize the programs of the National Bureau of Standards and the Office of Productivity Technology and Innovation for fiscal year 1985.

OVERALL NBS BUDGET LEVEL

The Committee welcomes the President's proposal to increase the funding for the NBS by $10.4 million. However, the budget proposal also included the elimination or severe curtailment of several critically important programs, including the fire research and building research programs. In order to maintain these programs the Committee is recommending a further small increase of $6.7 million for a total of $132.8 million.

The following Committee actions with respect to the fiscal year 1985 budget proposal are reflected in the bill H.R. 5172.

BUDGET TOTAL

The President's budget for fiscal year 1985 included a request of $126.1 for the National Bureau of Standards, representing an increase of $10.4 million above the fiscal year 1984 appropriation of $115.7 million; $3.4 million for the Office of Productivity, Technology and Innovation; and, as in fiscal year 1984 zero funding for the National Technical Information Service which has become self-sustaining.

H.R. 5172 would authorize the sum of $132.8 million for the National Bureau of Standards. This is $6.7 million above the President's request, and $17.1 million above the fiscal year 1984 appropriation. The Committee bill would authorize $4.1 million for the Office of Productivity, Technology and Innovation, a sum which is $750,000 above the President's request. H.R. 5172 would authorize

$500,000 to the Secretary of Commerce for the conduct of a Metric Study.

In addition, the bill would authorize excess foreign currencies for use by the National Bureau of Standards in the amount of $600,000, which is $100,000 below the fiscal year 1984 request.

INCREASES

The bill, as adopted by the Committee, reflects the following increases over the President's budget.

Engineering Measurements and Standards would be increased from $19.6 million to $23.2 million in order to restore funding for the Center for Building Research, which was eliminated in the Administration's budget.

Computer Science and Technology would be increased by $5.0 million from the Administration's request of $5.0 million to $10.0 million in order to restore this function to last year's level.

The Fire Research Center would be increased from the Administration's request of zero funding to $5.8 million in order to restore this function to last year's level.

DECREASES

Central Technical Support would be decreased by $6.6 million from the Administration's request of $21.7 million to $15.1 million. The $6.6 million decrease would provide no funding for the Administration's request of $2.0 million for the replacement of its aging telephone system, and would provide only about half the funding requested for a Class VI consolidated computing system to serve the computing needs of NBS and the Environmental Research Laboratory of the National Oceanographic and Atmospheric Administration (NOAA/ERL).

SPECIFICATIONS

Minimum funding levels are included in the bill for the fiscal year 1985 program for the following programs:

Of the $23.194 million authorized by the bill for Engineering Measurements and Standards, not less than $3.969 million would be available for the Center for Building Research.

Of the $10.0 million authorized by the bill for Computer Science and Technology, not less than $10.0 million would be available for this program.

Of the $5.827 million authorized by the bill for the Fire Research Center, not less than $5.827 million would be available for fire research.

COMPARISON WITH BUDGET REQUESTS

Committee actions on the President's budget request for the National Bureau of Standards and related activities are reflected in the table below:

NATIONAL BUREAU OF STANDARDS AND RELATED ACTIVITIES AUTHORIZATION, FOR PROGRAM ACTIVITIES, FISCAL YEAR 1985 (TITLE II, H.R. 5172)

[In thousand of dollars]

	Fiscal year 1984 appropriation	Administration changes	Fiscal year 1985 administration request	Fiscal year 1985 committee bill	Committee bill compared to—	
					Administration budget request	Fiscal year 1984 appropriation
Measurement research and standards	50,166	+8,573	58,739	57,948	−791	+7,782
Engineering measurements and standards	21,276	−1,715	19,561	23,194	+3,633	+1,918
Computer science and technology	10,000	−5,000	5,000	10,000	+5,000	0
Core research program for innovation	12,053	+271	12,324	12,168	−156	+115
Technical competence fund	8,169	+558	8,727	8,598	−129	+429
Fire research center	5,827	−5,827	0	5,827	+5,827	0
Central technical support	8,227	+13,484	21,711	15,065	−6,646	+6,838
Total NBS	115,718	+10,344	126,062	132,800	+6,738	+17,082
Excess foreign currency, NBS	700	−100	600	600	0	−100
Office of productivity, technology and innovation	3,625	−254	3,371	4,121	+750	+496
Office of Secretary Commerce (metric study)	0	0	0	500	+500	+500
NTIS	0	0	0	0	0	0
Title II total in bill	120,043	+9,990	130,033	138,021	+7,988	+17,978

Other Committee Actions

The following Committee actions which would provide for the use of appropriations made available to the National Bureau of Standards and for other purposes and which would amend the Bureau's Organic Act are also reflected in the bill H.R. 5172.

ORGANIC ACT AMENDMENT

A provision amending the Organic Act to permit retention of part of the fees collected for calibration services to pay for the replacement of equipment and inventories is included as Section 301.

A provision amending the NBS's Organic Act to raise the level of the Bureau's Director from V to IV on the Executive Schedule is included in Section 306.

OTHER PROVISIONS

A provision clarifying how a shortage of funds for possible salary increases in fiscal year 1985 is to be dealt with is incorporated as Section 302.

A provision specifying that funds appropriated under this Act shall remain available as specified in the Appropriations Act is incorporated as Section 303.

A provision permitting transfers of funds between program line items is included as Section 304.

A provision directing the Secretary of Commerce to charge for services mandated by law to be performed by the Bureau, or requested by another agency of the Government is incorporated in the bill as Section 305.

A section authorizing the Bureau of Standards to conduct investigations of structural failures in buildings, dams, and bridges is incorporated as Section 307.

2. COMMITTEE BUDGET ACTIONS, FISCAL YEAR 1985

National Bureau of Standards

The Committee expresses the following views explaining its budget actions for the National Bureau of Standards. It is noted, in connection with the overall level that would be authorized for the Bureau, that, in accordance with the provisions of the NBS Organic Act, extensive research and development activities are conducted on a reimbursable basis for other government agencies. The NBS estimates that in fiscal year 1985 such other agency work will account for an additional approximately $85 million in resources available for these specific tasks.

OVERALL NBS BUDGET LEVEL

The National Bureau of Standards (NBS), the Nation's oldest national laboratory and the lead agency for measurement science and standards, was created by the Act of March 3, 1901.

The basic mission of NBS is to apply its expertise in science and engineering specificially in the following areas: the custody, maintenance, and development of the Nation's standards of physical measurement and provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods for testing materials, mechanisms, structures, supplies and equipment; cooperation with other Federal agencies and the private sector in the establishment of standard practices; the provision of advisory services to government agencies on scientific and technical problems; and the invention and development of devices to serve special national needs.

The Committee believes that the National Bureau of Standards plays an important role as the Nation's measurement standards and generic technology development laboratory, and thus is vital to the country's efforts to increase productivity and achieve a higher level of industrial innovation.

LINE ITEM AUTHORIZATION

The authorization for the National Bureau of Standards is provided in 7 separate line items in Section 201(a) of the bill. These line items correspond to the major categories of the Bureau's total program, and are described below.

MEASUREMENT RESEARCH AND STANDARDS

Measurement research and standards development is performed by NBS's National Measurement Laboratory (NML). The NML continues to perform as a vital organizational unit of the Bureau. It provides a national system of physical and chemical measurement; coordinates that system with measurement systems of other nations; furnishes essential services leading to accurate and uniform

physical and chemical measurements throughout the Nation's scientific community, industry, and commerce; conducts materials research leading to improved methods of measurements, standards, and data on the properties of materials needed by industry, commerce, educational institutions, and government; provides advisory and research services to other Government agencies; conducts physical and chemical research; develops, produces, and distributes standard reference materials; provides standard reference data; provides calibration services; and collaborates with the Bureau's other major organizational units in carrying out its responsibilities. The Committee believes that these contributions can only enhance our country's role to improve measurement standards throughout industry and government, and the bill would authorize direct funding of $57.9 million for this subactivity.

ENGINEERING MEASUREMENTS AND STANDARDS

The National Engineering Laboratory (NEL) conducts the engineering measurement and standards activity of the Bureau. The NEL provides technology and technical services to public and private sector entities as they address national needs in areas such as public health and safety, measurement standards for the handicapped, regulatory reform, energy utilization, defense productivity, and international trade. To support this effort, the NEL conducts research in engineering and applied science, builds and maintains competence in the disciplines required to carry out this research and technical service, develops engineering data and measurement capabilities, provides engineering measurement calibration services, develops test methods, and proposes engineering standards and code changes. The NEL also proposes new engineering practices, improves mechanisms to transfer results of its research to the ultimate users and develops and demonstrates new institutional practices to stimulate the use of technology. The Committee supports the lead role the NEL plays in providing technical services and data which help to boost the Nation's productivity. The bill would authorize $23.2 million in direct funding for the efforts of the National Engineering Laboratory.

COMPUTER SCIENCE AND TECHNOLOGY

The Institute for Computer Sciences and Technology (ICST) conducts the computer science and technology program. Under authority provided to the Secretary of Commerce by Public Law 89-306 (Brooks Act), ICST carries out the following responsibilities to improve the Federal Government's management and use of automatic data processing (ADP): develops Federal ADP standards; provides agencies with scientific and technological advisory services relating to ADP; undertakes necessary research in computer science and technology.

The Committee believes the activities of ICST to develop standards for high level programming languages, software, computer system and network interfaces, computer security, and data base management are vital to the productivity and cost effectiveness of the Federal Government as well as private sector ADP users and manufacturers. ICST participation in developing international

standards is essential to reducing barriers to the flow of information and to trade. The bill includes $10.0 million for work in computer science and technology which would permit support for the development of international standards and research in support of standards development.

CORE RESEARCH PROGRAM FOR INNOVATION AND PRODUCTIVITY

The National Bureau of Standards has unique capabilities to assist in stimulating innovation in industry to sustain economic growth and improve productivity. The bill would authorize $12.2 million for the Core Research Program for Innovation and Productivity which is aimed at the advancement, through research and development, of selected generic technologies.

The Committee's hearings on technological innovation over the past five years have emphasized repeatedly: (1) the direct and significant relationship between R & D investment and technological innovation; (2) the importance of technological innovation in fostering increased productivity, employment opportunities, economic growth, and favorable trade balances; and (3) the national, social and economic importance of technological and enhanced productivity in combatting inflation.

In light of these findings, the Committee reaffirms the value of the Bureau's Core Research Program, which was established three years ago at the request of Congress. The bill would authorize $12.2 million for this program. Research areas, identified by the Committee as being of sufficient national technological importance to merit inclusion in this program, include: (1) Measurement Standards for Advanced Metals Processing; (2) the Semiconductor Program; (3) Automated Manufacturing Interface Standards; (4) Mechanical Engineering Metrology; (5) Robotics Research and Development.

TECHNICAL COMPETENCE FUND

In order to insure that the Bureau maintains and improves upon the underlying knowledge and skills necessary to meet the responsibilities delegated to it in the enabling legislation, additional legislative mandates, and administrative directives, research is supported from the Technical Competence Fund. These research projects (most are basic in nature) are of a long-term or theoretical nature. The decision to go ahead with a project is based on the potential that project holds for enhancing the Bureau's expertise in measurement science and technology. With this research base, the Committee believes the Bureau is in a better position to continue to respond effectively to emerging issues, and thus the bill would authorize $8.6 million for this purpose.

FIRE RESEARCH CENTER

The Fire Research Center was established by the Congress in 1974 by the Fire Prevention and Control Act to conduct research on the prevention and control of fires. The Committee strongly supports the continuation of the Fire Research Center and has provided funding in the amount of $5.8 million.

CENTRAL TECHNICAL SUPPORT

The bill would authorize $15.1 million for Central Technical support. Included in this line item are $2.7 million for the Research Associate Program; $3.7 million for Transfers to the Working Capital Fund to recover the replacement value of NBS depreciable equipment inventory and to provide for capitalization of Standard Reference Materials research and developments costs; and $.7 million for Facilities Modifications and Improvements to systematically replace aging and obsolete facilities. Also included are $8.1 million for Computing support. The $8.1 million, includes a $4.3 million increase for the FY 1985 costs of purchasing a Class VI consolidation scientific system, which will serve the computing needs of NBS and NOAA/ERL. The $8.1 million also includes a $2.0 million adjustment to restore funds temporarily reduced in the FY 1984 budget as a result of one-time savings due to delays in the acquisition of NBS central computer replacement. The Committee intends to review favorably a request next year for $4.6 million to complete the computer purchase in FY 1986.

FUNDING FLOORS

The Committee identified a small number of NBS program activities which were judged to be of exceptional importance. For these activities the bill would provide minimum funding levels.

CENTER FOR BUILDING RESEARCH

In the area of building research, NBS performs a vital role in providing the technical basis for codes and standards which are the heart of our building system in the United States. In addition, the Center for Building Research provides a basis for NBS to develop significant expertise in the area of building technology and thereby it is able to serve well the needs of the public when expert, third party investigations are requested following a building failure such as the Kansas City Hyatt Regency walkway collapse. These investigations, besides providing local governments and local officials with a very much needed service, also provide NBS with guidance for research efforts. The bill would provide a minimum of $3.969 million for this center.

COMPUTER SCIENCE AND TECHNOLOGY

NBS's Institute for Computer Sciences and Technology (ICST) follows a comprehensive plan for the development of federal automatic data processing standards and guidelines. The timely development of needed Federal standards is critical to the effective use of this rapidly emerging technology by the Federal government. Furthermore, ICST participation in developing international standards is essential to maintaining a U.S. competitive position in international trade. These important functions are dependent on adequate resources for supportive research and U.S. participation in international meetings. ICST has demonstrated the necessary expertise to make significant contributions in these areas. Therefore, the Committee has included in the bill a $10 million minimum for FY 1985

to ensure that these activities will be continued at a high level of quality and in a timely fashion.

FIRE RESEARCH CENTER

The Fire Research Center performs unique and much needed fundamental work on fire research including: predictive capability development, mathematical models of fire growth and spread, soot formation and thermal degradation processes. Test methods and proposals for voluntary standards and codes are also developed. The Committee has included a floor of $5.827 million, for the Fire Research Center.

EXCESS FOREIGN CURRENCY

The bill would authorize, $600,000 to be paid in foreign currency for expenses of the National Bureau of Standards incurred outside the United States.

OFFICE OF PRODUCTIVITY, TECHNOLOGY AND INNOVATION

The bill would authorize $4.1 million for the Assistant Secretary for Productivity, Technology and Innovation (OPTI). His Office serves as the focal point for efforts to develop policies and cooperative activities between government and industry to find solutions to the nation's problems of technological innovativeness and industrial productivity. The sum authorized would permit OPTI to move forward with programs of policy studies, the coordination of Federal patent policy, and voluntary conversion to the metric system.

In addition, the sum authorized would fund OPTI's Industrial Technology Partnership (ITP) Program, designed to stimulate higher levels of private R&D investment in the U.S. A main focus of this program is to facilitate the greater use by the private sector of R&D limited partnerships. While not joint or cooperative research ventures, these partnerships are designed to foster large-scale R&D efforts that are beyond the risk threshold of individual companies. The use of R&D limited partnerships minimizes antitrust and other legal problems, and also builds on existing tax incentives that reduce the risks associated with attempting to develop new advanced technologies.

The $4.1 million authorization includes $750,000 to substantially increase the availability of Japanese science and engineering literature to United States scientists and engineers through increased accessibility, monitoring, screening, translation, abstracting, indexing, dissemination, awareness, and marketing. The Assistant Secretary of Commerce for Productivity, Technology and Innovation is authorized to make grants and contracts with private for-profit, nonprofit, and educational organizations and to provide funds to other government organizations, to coordinate with other government organizations, and to utilize the Director, staff, and facilities of the National Technical Information Service for this purpose.

NATIONAL TECHNICAL INFORMATION SERVICE

The National Technical Information Service (NTIS) makes available to the public the technical information resulting from federal-

ly funded research and development activities. This is done by collecting, processing and disseminating technical reports and other information products generated by the research. NTIS' enabling legislation (15 U.S. Code 1151-7) also requires that NTIS perform this function with respect to technical information originating outside the Government when it is practical and desirable. In 1984, NTIS is expected to become self-supporting from sales revenues.

3. ADDITIONAL PROVISIONS OF THE BILL

TITLE III—ADDITIONAL PROVISIONS

COST RECOVERY AUTHORITY (SEC. 301)

An amendment to the NBS Organic Act would provide for cost recovery authority so that net income would be used to replace equipment and inventories before the net sales proceeds are paid into the general fund of the Treasury.

SALARY ADJUSTMENTS (SEC. 302)

The bill would provide for authorization of additional appropriations in the event of a Federal pay increase during fiscal years 1984 and 1985, and if the full amount is not appropriated, then adjustments are to be made proportionally from the line items.

AVAILABILITY OF APPROPRIATIONS (SEC. 303)

A provision specifying that funds appropriated under this Act shall remain available as specified in the Appropriations Act is included in this bill.

TRANSFER OF FUNDS (SEC. 304)

The bill also includes a section which would provide a limit of 10 percent on the funds to be transferred between line items subject to Congressional notification and review.

ACTIVITIES PERFORMED FOR OTHER GOVERNMENT AGENCIES (SEC. 305)

The Secretary of Commerce would be directed to charge for services mandated by law to be performed by the NBS or requested by another Agency of the Government.

DIRECTOR OF THE BUREAU (SEC. 306)

An amendment to the NBS Organic Act would provide that the Director of NBS be changed from a Level V to a Level IV of the Executive Schedule.

INVESTIGATION OF STRUCTURAL FAILURES (SEC. 307)

The bill would provide authorization for NBS to conduct investigations of structural failures of buildings used or occupied by the general public, and other public structures.

4. COMMITTEE VIEWS

In addition to the foregoing considerations and analysis which are reflected in the bill, the Committee directs the attention of the National Bureau of Standards and the Secretary of Commerce to the following Committee Views and, where appropriate, asks the Bureau or the Secretary to take the required action.

Fire Research Program

For the second consecutive year the Administration would eliminate entirely the fire research program at the National Bureau of Standards. The basis for this proposed elimination is the theory that much of the research now done at the Bureau's Center for Fire Research can and will be done in the private sector. Both this year and last year the Committee conducted extensive hearings to ascertain whether that is in fact the case. Although the Committee heard from a wide range of witnesses representing industry and industrial and public sector associations, no basis was found for the expectation that others would perform this research. The Center for Fire Research conducts the only comprehensive fire research program in the country. Its program is designed to provide the scientific basis for the prevention and control of all types of fires. It is directed particularly toward reducing the problem of residential fires which account for the majority of fire-related deaths and injuries in the United States. The Committee is unable to agree with the proposal to eliminate the fire research program at the Bureau, and recommends that the program be continued in fiscal year 1985 at the level of $5.8 million, which is identical to the level authorized and appropriated in fiscal year 1984.

Center For Building Research

The Committee reaffirms its support for the continuation of the Center for Building Research which has again been proposed for elimination in the fiscal year 1985 budget request. Research conducted at the Center provides the technical basis for voluntary standards, building codes and specifications through development of improved measurement techniques, test methods, and technical data not available from other sources. The Committee believes that the work carried on at the Center has led to greater building reliability and durability and enhanced safety of construction, as well as reduced cost of buildings. Furthermore, the Committee believes that the Bureau is in a unique position to provide unbiased and pertinent information in this field. Finally, the Committee does not believe that the private sector and local governments can or will carry out the type of nonproprietary technical research needed in this area and, accordingly, has restored funding in the amount of $4.0 million for the Center for Building Research.

Computer Science and Technology

The Committee reaffirms its view that the Bureau of Standards has a direct role not only in standards setting for the rapidly developing field of computer and information technology but also in assessing and influencing the broader national impact of this field.

Accordingly, the Committee has restored funding to last year's level of $10 million. The committee believes that the mission of the Institute for Computer Sciences and Technology (ICST) is essential to the development and implementation of a coherent national information policy and to the management of federal information resources. The Committee remains convinced that NBS should give high priority and adequate support to the functions and missions of ICST. The ICST's current mandate requires the development of standards and guidelines which lead to the economic and efficient purchases, lease, maintenance, operation and utilization of automatic data processing equipment within the Federal government and to conduct whatever research is necessary to meet that goal. In addition to national standards development, the Committee would also like the ICST to continue addressing computer security issues; the assessment of new technologies, including parallel processing; applied research and development in test methods and performance measures; and international networking.

The Committee reiterates its position that ICST Competence funded projects have made a significant contribution to the ICST mission and are necessary to maintain staff competence for both advisory services and automated data processing standards. The Committee is pleased that the Committee funded projects have been reinstated for ICST and anticipates that ICST will continue to receive competence funding in fiscal year 1985 and succeeding fiscal years.

Scientific Computing Capability

The Committee strongly supports the acquisition of a class VI consolidated scientific computing system to serve the computing needs of the National Bureau of Standards and of the National Oceanographic and Atmospheric Administration's Environmental Research Laboratory. The Committee believes that the proposed consolidated system will provide NBS and NOAA/ERL with the required computing capacity for present and future needs and will do so in the most cost effective manner due to operating efficiencies and economies of scale. However, in recognition of the severe budgetary constraints in effect this fiscal year, the Committee has decided to fund only $4.3 million of the Administration's request of $8.9 million for the Class VI computing system. The Committee believes that NBS's request of $8.9 million is based on an overly optimistic schedule of procurement, installation, testing, and final payment in Fiscal Year 1985. The Committee believes that NBS and NOAA/ERL funds now in hand, plus the fiscal year 1985 authorization of $4.3 million, should adequately cover Class VI computing funding needs in Fiscal Year 1985. In order to complete the procurement of the Class VI computing system in FY 86, the Committee will favorably consider a Fiscal Year 1986 budget request for the additional $4.6 million required.

Research Facility Utilization

Since the National Bureau of Standards moved to its new campus in Gaithersburg, Maryland in 1964, a significant number of new, modern and costly research facilities have been acquired. In

recent years, due to a number of factors which include fiscal constraints, personnel realignments and shifting research priorities, it appears that the less than full use of some of these research facilities is resulting in a notable underutilization. At the same time the Bureau has continued to seek funds for the updating and modernization of these research facilities and for the acquisition of new research facilities. In order to obtain a solid factual base on which to judge this question of possible research facility underutilization, the Committee has asked the General Accounting Office to conduct a survey of this matter and to provide an analysis of the results. The Committee asks the Bureau to cooperate fully in the conduct of this GAO study and to be mindful of the need to manage the facilities entrusted to it in an optimum manner.

Investigation of Structural Failures

The bill includes a new provision, incorporated as Section 307, which would authorize the National Bureau of Standards to conduct, on its own initiative, and in cooperation with the appropriate state and local authorities, investigations to determine the technical factors contributing to structural failures in structures which are used by the general public. This new authority was recommended following a careful review undertaken by the Committee's Subcommittee on Investigations and Oversight of a number of structural failures in public structures such as buildings, dams, and bridges. The review was undertaken because of the apparent increase in the number of such failures and the need to prevent them in the future. The legislative authority which would be provided to the Director of the National Bureau of Standards would permit the rapid entry of the Bureau into investigations where structural failures have occurred, would provide for the compilation of technical reports on such investigations, and would direct the Secretary of Commerce to disseminate widely the reports containing the results and recommendations. The Committee wishes to emphasize that the NBS would not have a regulatory role in the construction industry. Instead, any conclusions and recommendations made by the NBS as the result of an investigation would be advisory only. It is the intent of the Committee that the Bureau move forward vigorously but carefully, and with the aim of developing reports which can, without delay, benefit the public. Hence, the Committee asks the Director of the National Bureau of Standards, after this provision becomes law, to submit to the Committee 20 months after its enactment, a report describing the investigations conducted and their impacts, and recommending any needed changes in this legislative mandate.

Evaluated Engineering Data

Public Law 90–396, enacted by H.R. 6279 in 1968, provides for the collection, critical evaluation, publication, and sale of standard reference data, and NBS was given this responsibility. Up to the present time, the NBS Office of Standard Reference Data has focused its attention primarily on physical and chemical data. The computer age has revolutionized the ways of science and caused an increased need for reliable data particularly in computer-readable

form. Thus, a critical disparity has grown between the needs and the availability of evaluated data not only in physics and chemistry but particularly in the engineering field. Until now, there has been no coordinated effort in this field and the current piecemeal approach has left the few data centers that do or did deal with the subject with a totally inadequate funding base. Even then, several of these centers were oriented towards bibliographic information. Our computer-trained engineers require computerized systems that provide best available numerical data that are extracted by experts from the literature. This need is especially critical for the many smaller-sized but highly innovative industries that require interdisciplinary data use.

NBS should reassess its role in materials and engineering data, looking to coordinate and co-support a national data resource. Where better standards are required for test methods, definitions, units, nomenclature, reference materials and validation methods, NBS should take the leading role. Where national centers of topical expertise exist, NBS should take an increased interest in support of this work, and coordinate where necessary, with other data system initiatives that are in progress.

Industrially competitive nations are fully aware of the value of data resources and are taking appropriate action. NBS should take its mandated role seriously in materials data and vigorously address action for our nation, to stimulate a resourceful environment for our technology-based economy.

Budget Request Financial Presentation

The Committee's analysis of the Bureau's annual budget request is based principally on the annual volume containing the "Congressional Budget Justification", the so-called Budget Book. If the Committee is to understand the past, present and proposed levels of resources for individual programs and initiatives under consideration, and make recommendations to the House about the levels to be authorized for appropriations, the figures presented in the Budget Book must accurately reflect the purposes for which they are designated. The Committee must have confidence that when it analyzes the budget figures and makes recommendations about them, the figures on which its work is based are in fact valid. The need to make additional manipulations through additions and subtractions to the figures presented, before an accurate picture emerges is wasteful, unnecessarily complex, and can potentially be misleading. The practice of including in some of the budget figures additional sums for such purposes as overhead for unrelated programs and other forms of contingency reserves should be discontinued, and other, unambiguous ways of presenting the budget should be employed. The Committee has worked in recent years with the Bureau to improve the content of the Budget Book, and much progress has been made. The Committee is appreciative of the agency's effort in this respect, and urges that this particular problem be addressed forthwith.

Japanese Science and Engineering Literature

As the world's third largest scientific research establishment, Japan is making significant contributions to science and technology. However, the United States is not getting the benefit of this information because it does not have an adequate system that government and industry can use to explore technical developments in other nations, especially Japan.

The Committee is concerned about the imbalance of the exchange of scientific and technical information between the United States and Japan and believes that Federal funding is required to correct this situation. Accordingly, the Committee recommends that the sum of $750,000 be authorized to be expended for the purpose of increasing the availability of Japanese science and engineering literature to U.S. scientists and engineers, through increased monitoring, screening, translation, abstracting, indexing, dissemination, and marketing. For this purpose, the bill would authorize the Assistant Secretary of Commerce for Productivity, Technology and Innovation to fund grants or contracts with private, non-profit, and educational organizations, to provide funds to other government organizations, and to coordinate with other government organizations. In addition, the bill would authorize that the Director, staff, and facilities of the National Technical Information Service be utilized for all or part of this effort.

Metric Evaluation Study

The Metric System of Weights and Measures is now in use throughout the world. Since 1945 most of the English speaking countries around the globe, which previously were using the English system of measurements, have changed to the Metric system, or, in the case of Great Britain, are now in the process of making that change. Currently only Burma, Brunei, and the United States are not committed to using the Metric system. Today the U.S. is also suffering from a serious deficit in our balance of trade. U.S. firms with a strong reliance on foreign sales have slowly gone Metric in response to the demand of the international marketplace. It is appropriate and timely that a comprehensive survey of the current status of Metric conversion be made so that its role in U.S. international competitiveness can be ascertained and, if necessary, strengthened. The study for which $500,000 would be authorized in this bill would provide the Congress and the Executive Branch with the factual basis on which to base Federal policy decisions in this important field.

5. EXPLANATION OF BUDGET CATEGORIES, FISCAL YEAR 1985

The detailed program activities and subactivities that would be performed under the proposed budget levels in the bill are described in this section.

NATIONAL BUREAU OF STANDARDS

1. MEASUREMENT RESEARCH AND STANDARDS (Sec. 201(a)(1)) $57,948,000

This activity encompasses a broad program of research in measurements and standards being performed by the National Measurement Laboratory. The subactivities include Fundamental Physical Measurements and Standards, Radiation Measurements and Standards, Analytical Chemical Measurements and Standards, Materials Characterization, Processing and Performance, Chemical Properties and Processes, and Measurement Technology Transfer and Applicable Measurement Programs. A description of these subactivities follows:

FUNDAMENTAL PHYSICAL MEASUREMENTS AND STANDARDS..... $14,428,000

This program maintains and improves standards for the physical units of time and frequency, temperature, pressure, length, mass, voltage and electrical resistance. Measurements and calibrations made against these standards are disseminated to the point of use through transfer standards or other appropriate mechanisms. Virtually all types of industrial activities, research and development work in science and medicine, and the national defense system depend on support from this program. Fundamental physical constants affecting broad areas of scientific endeavor and industrial activity are measured using the staff expertise and instrumentation available at NBS. The program plays a vital role in industrial product control essential for economic recovery and the international competitive position of U.S. industry.

The scientific and technical expertise developed under this program is accessed by other government agencies on a reimbursable basis. For example, the Department of Defense (DOD) has a continuing program with NBS to provide time and frequency measurements in support of timekeeping requirements for defense communications and the Global Positioning System. Additionally, DOD has requested that NBS develop and evaluate hydrogen maser frequency standards and provide very stable electrical transfer standards for use in calibrating military instruments and equipment. The Department of Energy (DOE) has contracted NBS to conduct research in vacuum measurement technology to provide vacuum standards for various fusion research and development projects. NBS was requested to perform this research because of its staff expertise and unique capability in the development of fundamental standards and new measurement methods and because of requirements that measurements of other agencies be traceable to national standards.

Recent accomplishments include the following:

Completion of an operational intercontinental time transfer system with 10 nanosecond accuracy in order to fulfill NBS responsibilities for national and international time and frequency dissemination.

Completion of the automation of NBS' facility for measuring resistance standards in the range 0.01 teraohms to 100 teraohms in order to provide industry with the required measurement accuracy.

Completion of the construction of a prototype, high-accuracy automated balance (kilogram mass comparator) for improved maintenance of the U.S. national standards of mass.

Planned accomplishments in fiscal year 1985 include the following:

Complete design, construction and testing of a new bridge for measuring inductors over the range 100 microhenry to 10 henry and to frequencies of 100 kilohertz. Incorporate this bridge into NBS' electrical calibration service, thereby allowing traceablity of inductance measurements to the U.S. legal standards, with the accuracy required by high technology industry.

Compare NBS long optical fiber thermometer with NBS gas thermometer from 600°C to 960°C with target accuracy of 100 parts per million. Comparison of these two instruments based on different physical laws could resolve the serious discrepancies that exist between national standards laboratories in the definition of a temperature scale above 630°C.

Complete research for, and development of, a prototype, optically-pumped frequency standard that will be ten times more accurate than the present standard. This will provide scientific basis for field devices for industry, Government agencies and intermediate calibration laboratories.

Measure specific interactions between electrons and ions that influence the modeling of astrophysical and fusion plasmas.

PROCESS AND QUALITY CONTROL INITIATIVE $2,500,000

The budget level in the bill for the Fundamental Physical Measurements and Standards program includes an increase of $2,500,000 and 20 positions to expand a program of measurements for process and quality control. This increase will enable NBS to provide new and improved services to industry and Government agencies by strengthening the measurement science base in those areas where NBS has direct responsibilities to the industrial community.

Two major trends in American industry are placing significant new demands on the Bureau's measurement capability. One is the increased use of high technology in the manufacture of sophisticated products; the other is the emphasis on process and quality control to ensure that the specifications required for proper performance of these products are met throughout the production process. Industry continues to look at NBS for leadership in measurement research, capability, and services, but in certain areas NBS lacks the measurement base to respond adequately.

This initiative addresses high priority measurement requirements identified by national organizations and endorsed by a panel of industrial and government experts. New scientific discoveries, coupled with recent technological developments, offer unprecedented opportunities for NBS to expand the Nation's capability to measure. The specific areas to be addressed are electrical and electronic measurements and standards, optical radiation standards, ionizing radiation and dosimetry standards, and vacuum and leak rate standards. The initiative also includes funding for efforts in

mathematics to ensure proper statistical control of the measurement services offered.

An example of the need for expanded measurement capability is in electrical and electronics measurement. The increasing use of precision electrical and electronic instrumentation and test equipment permeates the high technology and defense industries and a large segment of the manufacturing community. In response to current needs for better quality control in this area, NBS will develop new automated measurement systems with improved accuracy, higher measurement speed, and extended frequency and sensitivity ranges; develop new methods to measure dissipation factors of high quality capacitors used in electronic sample-and-hold devices; and develop low temperature noise sources and radiometers to extend noise calibration services to communication and other high performance systems.

Expanded measurement capability is also required in the area of radiation therapy in response to changing medical practices. A stringent accuracy of 3 percent is required in the measured dose owing to the small difference between the radiation level necessary to control a tumor and that at which normal tissue is damaged. Two large and rapidly growing methods of radiation therapy are high-energy X-rays and high-energy electrons produced by linear accelerators and betatrons. The accuracy available in radiation therapy centers for high-energy X-rays is not known. For high-energy electrons, the NBS dosimetry service has shown about 40 percent of the respondents to be outside even a 5 percent accuracy limit. In response to this need for greater accuracy in radiation measurements, NBS will develop a standard source/detector setup for a quality assurance program, select and calibrate transfer instruments, develop passive dosimetry systems, circulate instruments and dosimeters to intermediate laboratories and evaluate results to maintain measurement traceability, and develop and document measurement protocols.

In addition to expanding present measurement capabilities, this initiative will enable NBS to establish standards for quality control in several new measurement areas. For example, NBS will establish a calibration facility for leak-rate and high vacuum standards, which are urgently needed by almost every sector of the manufacturing industries, by the industrial research community, and by major national programs such as the nuclear and fusion energy programs. Applications for these standards range from determinations of the rate of escape of freon in refrigeration units to determinations of the accuracy of airplane altimeters, critical to the Federal Aviation Administration in modifying their requirements for aircraft separation limits.

Finally, this increase in funding will enable NBS to provide data and measurements needed by industry to develop guidelines and voluntary standards to demonstrate compliance with regulatory requirements. Regulations are often based on specifications and concentrations that cannot be readily measured by industry. This program will develop the portable transfer standards and measurement base required to transfer the necessary measurement capability from the laboratory to industry.

In summary, NBS will carry out research to develop the necessary scientific base for new and improved measurement services and to provide key data. NBS will also develop new and improved standards, instrumentation, and measurement methods to transfer traceable calibration capabilities to the private sector. Automated calibration systems or facilities will be built up in those measurement areas where feasible. Documentation and training material will be provided to accelerate the transfer of measurement technology to users. The user communities most affected will be high technology industries (i.e., computer, aerospace, communications, electro-optics, radiation processing and therapy, and instrumentation) and the defense establishment, which urgently needs improved quality control to develop and maintain complex defense systems.

RADIATION MEASUREMENTS AND STANDARDS..... $9,708,000

This program conducts basic and applied research in nuclear radiation physics, optical radiation physics, plasma physics, ultraviolet physics, electron physics, and nuclear structure in order to improve the understanding of the interaction of radiation with matter. Using this research as a basis, NBS is developing standards for radiography, dosimetry, optical and ultraviolet radiation, radioactivity, gamma and X-rays, neutron beams and fields, and plasmas. NBS is also publishing critical data on atomic transitions and the interaction of ionizing radiation with matter. These standards contribute to the technical base for measurements related to the design, operation, and safety of nuclear power plants and for measurements made by such diverse groups as the electro-optics and communications industries, the photographic industry, the lamp and optical instrumentation industry, the radiation processing industry, hospitals, and Department of Defense standards laboratories.

The scientific and technical capability developed under this program is used to respond to the measurement requirements of industry and other government agencies on a reimbursable basis. An example of NBS research conducted with other agency funding (DOE) is measurement research for the nuclear power industry in the area of neutron dosimetry measurements, which are used to monitor reactor pressure vessel integrity. A second example of support provided to other agencies (DOD and NASA) is in ionizing radiation dosimetry needed in occupational exposure monitoring, medical therapy and diagnosis, and radiation sterilization of medical supplies and food. NBS was requested to perform this research for other agencies because of its expert staff and unique measurement capabilities involving standards for optical, ultraviolet, electron and neutron radiation. Additionally, NBS measurements establish traceability to national standards which is often a requirement in procurement and safety specifications.

Recent accomplishments include the following:

Development of gamma-ray emission-rate standards for determining the concentrations of radioactive elements as found, for example, in the gaseous effluents from nuclear power plants.

Establishment of a new national standard of absorbed radiation does based on calorimetric measurements in water. This

will improve the accuracy and quality control of measurements of radiation effects on the human body as, for example, in radiation treatment of cancer.

Development of radiation probes for measuring the properties of high temperature plasmas, such as those produced by high power lasers and fusion devices being developed as energy sources of the future.

Planned accomplishments in fiscal year 1985 include the following:

Analyze spectroscopially the structure of highly stripped ions to find magnetic dipole transitions suitable for determining the ion temperatures in fusion plasmas. Measurement of these temperatures provides an important diagnostic test of the plasma's ability to induce fusion reactions.

Complete measurements of the 235U neutron-induced fission cross section in the neutron energy interval from 1 electron volt to 20 million electron volts with an uncertainty of two percent. This reaction serves as the fundamental standard for nearly all neutron fluence and fission determinations required by the nuclear industry.

Develop X-ray measurement methods and standards using digitization techniques and computer image processing. These methods and standards are needed to support the development of instrumentation and applications in medical, dental, and industrial radiography.

Establish highly accurate spectrofluorimetric standards for nondestructive evaluation, clinical analysis, and for use in the paper, textile, and paint industries.

ANALYTICAL CHEMICAL MEASUREMENTS AND STANDARDS $2,767,000

This program provides standards and measurement methods for high accuracy chemical analyses in support of the chemical, clinical, instrument manufacturing, and metals producing industries, and of many Federal programs related to environmental pollution, toxic substances, and health services. Approximately 150 million chemical analyses are made daily in the United States, with annual expenditures estimated at $50 billion. These analyses consist of automated, single and multispecies determinations in areas affecting approximately two-thirds of the GNP. A broad range of industrial areas are served, including raw and finished materials, food processing, waste management and diagnostic technologies. Many important decisions are based on chemical analyses including those concerning the medical treatment of people, the abatement of pollution, and market place equity. The reliability of these analyses assumes great significance for both personal well-being and cost control.

Measurement expertise developed under this program also enables NBS to respond to the research and development requirements of other agencies on a reimbursable basis. For example, NBS was requested by DOE, EPA, and NRC to develop reference methods and quality control/assurance samples for waste leachates, sludges, shale/crude oils, toxic organic gases and air particulates needed to support environmental regulation, measurement, and research needs. Additionally, NBS developed advanced measurement

capabilities and standards for the chemical compositional analyses of materials and submicrometer particles to provide DOD, EPA, and the materials industries with capabilities for source identification, process characterization, and determination of catalytic activity, as well as determining mechanical, physical, and chemical properties. NBS was requested to perform this research because of its staff capability in the areas of chemical analysis, and in the provision of precise and accurate measurements. In addition, NBS serves as a neutral third party thereby avoiding potential bias in the presentation of research results.

This program also produces Standard Reference Materials (SRM's) which are provided on a reimbursable basis to industry and Government agencies for a wide variety of uses. In providing SRM's, this program analyzes samples and certifies their elemental or molecular composition. Examples of such SRM's include: gases in metals and other high technology materials which are used in the metals and aerospace industry, human serum with inorganic and organic constituents which is used by the health and medical communities; and a solution of priority pollutants in a hydrocarbon matrix which is used by enviromental, regulatory, and health groups. In all of these cases the respective SRM's provide the basis for assessing measurement accuracy and reference to the national measurement system.

Recent accomplishments include the following:

Development of methodology for neutron depth profiling of helium, bismuth, and nitrogen in solid materials to enable nondestructive three-dimensional compositional analysis of critical high technology materials.

Application of two-dimensional electrophoretic techniques to the qualitative/quantitative analyses of proteins to establish an accurate basis for the characterization of proteins in industry and in clinical laboratories.

Performance research on absolute measurement methodology for the analysis of small gaseous molecules by laser absorption photometry to achieve the increased selectivity and sensitivity required for pollution abatement measurements.

Generation of a predictive model to be used for reducing interference effects in laser-enhanced ionization in flames.

Planned accomplishments in fiscal year 1985 include the following:

Develop two-dimensional, two-color laser-enhanced ionization methods to improve selectivity in analysis of individual elements in complex matrices such as soils or industrial waste samples.

Investigate spark sampling phenomena in excitation sources using Schlieren, fluorescence, and interferometric techniques to develop an improved technique for more sensitive and accurate spectrochemical analysis. Spectrochemical analysis is commonly used for determining the composition of metals or alloys.

Investigate supercritical fluid chromatography for separations and coupling to mass spectrometry for determining trace organic components in environmental, food, and clinical samples.

Develop quantitative elemental and isotopic analytical methods for submicrometer particles using microbeam techniques. The analysis of these small particles is important for environmental questions and quality control for high technology industries.

MATERIALS CHARACTERIZATION, PROCESSING, AND PERFORMANCE..... $17,503,000

This program is responsible for providing evaluated data, measurement methods, standards and reference materials, concepts, and other technical information to industry, Government agencies, universities, and other scientific organizations. The program supports generic technologies in materials in order to promote their safe, efficient, and economical use. Research addresses the science underlying new and existing advanced materials technologies together with the associated measurement methodology. The program has four complementary components: materials processing, microstructure characterization, properties, and performance. Each of these components involves metals, polymers, composites, ceramics, and glass.

Materials processing research provides measurement technology and basic scientific information relating processing variables and materials performance. This information, much of which is made available through major cooperative programs, promotes industrial development of innovative materials including high performance ceramics and composites, improvements in manufacturing processes, increased productivity and reliability in structural welding, and advances in materials design. The effects of variables such as pressure, temperature, and mechancial stresses are studied to provide a basis for optimizing the production of internal structures which will impact specific materials properties appropriate to desired performance. This information is used in industry for processing bulk materials into forms suitable for different uses.

Microstructure characterization methods are developed to support design and production of advanced materials which have new microstructures and new structure/property relationships. Measurement methods include optical and electron microscopy, acoustic emission, ultrasonics, and X-ray and infrared spectroscopy. The NBS nuclear reactor, operated in this program, is a national experimental facility with unique capabilities for a wide variety of microstructure studies in ceramics, metals, and polymeric materials. It provides neutron diffraction, inelastic scattering and neutron radiography capabilities which are made available to industrial and academic researchers as well as other Federal agencies and other NBS programs. The NBS X-ray synchrotron provides facilities for sophisticated materials characterization techniques, real time phase transformation studies, state-of-the-art topography, which is potentially useful for nondestructive evaluation, and diffraction as a function of pressure in a cell capable of extremely high pressures.

Properties research includes experimental data collection and theoretical investigations of technologically promising and scientifically important materials to develop and provide key data and correlations between internal structure and properties in the areas of wear, mechanical properties, optical properties, and ionic conduc-

tion. This information, in turn, is used by the private sector to design products with optimum performance characteristics.

Performance characteristics of materials are identified, and predictive methods for maximizing performance and service lifetime are developed. The first major emphasis in the area of performance is on fracture mechanics and on weld performance of commercially important alloys, especially steels and aluminum alloys used widely in critical structural applications such as bridges, pipelines, ships, aircraft, and offshore structures. The second consists of environmentally sensitive fracture mechanics which include stress corrosion cracking of metals, and environmental effects in brittle fractures of ceramics.

This program provides the measurement services needed for the optimization of materials processing, materials selection, new materials development, and performance in service. The expanding application of high-performance materials in our technologically based society requires more precise, accurate, and sophisticated measurement techniques to characterize important new materials. These applications also require better materials property specifications and data for the wide variety of materials currently in use. Materials standards and reliable measurements are needed to monitor performance characteristics and ensure equity in commerce. Increases in the productivity and efficiency of materials processes made possible by these measurements will improve the competitive position of the United States in world trade through the use of lower cost raw materials; more efficient processing; the reduction of process costs, including more efficient use of energy; and the reduction of loss through materials fracture and failure.

Expertise developed in the STRS program was used in support of other agency and reimbursable programs. For example: the behavior of structural ceramics for advanced heat engine and heat exchanger applications was determined for the Department of Energy; measurement methods to improve the processing of reinforced composites were developed and applied to quality assurance methods for the Bureau of Engraving and Printing to control currency print quality and lower production costs; NBS-developed corrosion measurement techniques were applied to the determination of corrosion rates of steel reinforcing bars in concrete bridge decks for the Federal Highway Administration; and extensive use of the NBS nuclear research reactor was made by the FBI, the FDA, EPA, and other agencies for analysis of criminal artifacts, food and drugs, and environmental pollutants. NBS was requested to perform these research efforts because of its expertise in providing critically evaluated, nonproprietary data and research results.

Recent accomplishments include the following:

Performance of center and edge crack panel measurements to verify elastic-plastic fracture relationships among flaw size, applied strains, and material toughness for the development of fitness for service standards for critical structures.

Development of a technique for measuring delamination of polymer matrix composites under impact. This technique will provide data for design improvements to control this frequent cause of structural composite failure in service.

Measurement of a low-energy vibrational density of states of atoms and chemical species bound at the surface of metallic particles and catalysts of submicron size. These measurements will provide information on the dynamics and chemical interaction potentials related to heterogeneous catalysis.

Determination of the effects of microstresses induced by phase transformations or thermal expansion anisotropy on crack growth behavior in polycrystalline ceramics. This information will allow lifetime predictions to be made for structural ceramics where flaw sizes are of the same magnitude as the grain size.

Planned accomplishments in fiscal year 1985 include the following:

Use small angle neutron scattering (SANS) and other high temperature measurement techniques to characterize the evolution of critical flaws in model ceramic microstructures. This information will provide a basis for improved ceramic processing and the nondestructive evaluation needed for product reliability.

Develop a method for controlling porosity in ferrous welds and measuring pore dimensions using ultrasonic inspection techniques.

Complete novel light scattering instrument for measuring interdiffusion data on polymer blends. These are needed by the polymers industry to perfect processing of new polymer blends.

Extend pilot phase of new corrosion data program to include rate data for atmospheric corrosion of structural alloys and thermodynamic electrochemical-ph data for the iron-chloride-water system. This is a collaborative effort with the National Association of Corrosion Engineers to produce data needed to select alloys for use in corrosive environments.

Complete neutron scattering study of the dynamics, interatomic bonds, and phase transitions in new classes of two-dimensional alloys and complexes created by insertion of atoms or molecules in graphite. These two-dimensional alloys are important models for the behavior of materials surfaces or thin films.

COLD NEUTRON SOURCE INITIATIVE $1,500,000

The budget level in the bill for the Materials' Characterization, Processing and Performance program includes an increase of $1,500,000 and 6 positions to develop a prototype cold source and instruments for cold neutron research on materials. This request is the first step in providing U.S. scientific and industrial communities with new critical measurement capabilities using cold neutron beams to study the properties, performance, and processing of materials and chemicals which cut across all areas of our industrial economy. This research and development project is an important advance over current facilities in this country and provides the basis for the establishment of a U.S. center for cold neutron research at the National Bureau of Standards.

The United States is far behind other industrialized countries, particularly German, France, and Great Britain, in the development of cold neutron research facilities. High intensity cold neu-

tron beams open up totally new research opportunities for all major types of materials, including metals, ceramics, polymers, and new materials for device technology, catalysis, and biotechnology. Over $100 million has already been invested in cold neutron research and facilities in Western Europe, and the Japanese government has recently approved a major expenditure for a cold neutron research effort. Creation of such a facility in the private sector in the United States is not feasible because of the capital investment required to construct a research nuclear reactor (no appropriate research reactor currently exists in the industrial or university communities), and the necessity for construction of substantial auxiliary facilities. Among the several major neutron sources in this country, only the NBS research reactor is designed to allow the installation of a cold source of sufficient volume for the development of the flexible array of instruments needed to give the U.S. research community a capability competitive with the best in the world. The function of the cold source is to increase the number of low energy and long wavelength neutrons available for experiments. The upper limit of the sizes of structures that can be measured by small angle neutron scattering methods depends on the neutron's wavelength. The availability of intense beams of long wavelength neutrons from the cold source will more than double the size range accessible to the present NBS instrument. The kinetics of a number of important phase transformations such as crystallization in metallic glasses or phase separation in polymer blends, which are critical to their performance in new product applications, will be studied in real time. Moreover, the cold source will provide for greatly increased sensitivity and resolution of cold neutron studies of dynamic processes and of materials.

In order to provide the first step in the establishment of a world-class cold neutron capability for the United States, NBS will develop and maintain a prototype cold neutron source and two instruments optimized to take advantage of the low-energy neutrons provided by the source. The two instruments, a high-sensitivity small angle neutron scattering system and a high-resolution time-of-flight neutron spectrometer, will provide essential new measurement capabilities, e.g., for nondestructive evaluation of mirostructure and defects in advanced metals and ceramics and for in situ measurements of molecular processes on industrial catalysts at pressures and temperatures present during chemical production. These advances are made possible by the deep penetration and special scattering power of cold neutrons. The advanced measurement technology introduced in this initiative will have broad application in basic and applied science in the materials, communication, chemical, and electronic industries; and, at the same time, provide the basic knowledge and design criteria needed to develop, in the near future, a world-class cold neutron research facility providing the many instruments needed to help our materials-based industries and scientific community compete successfully with other industrialized nations.

CHEMICAL PROPERTIES AND PROCESSES..... $6,822,000

This program provides the technical communities with research results and measurement methods dealing with fundamental

chemical processes, chemical and physical properties of matter, and the manner in which these processes and properties change with temperature, pressure, and chemical composition. The measurements, standards and data of this program are important in such areas as chemical manufacturing, energy conversion, and atmospheric monitoring. The program's primary long-term emphasis is on producing predictive models which will eliminate or minimize the need for costly laboratory measurements. Chemical properties are studied at the atomic and molecular levels. State-of-the-art experimental facilities are maintained to obtain fundamental measurements of the transients or intermediates in chemical processes in order to understand how reactions occur and what the energy requirements are for selection among alternate reaction paths. Theoretical efforts are combined with experimental efforts in order to minimize the number of experiments required and maximize the usefulness of the output. Recently, research programs have been started in the areas of condensed phase and surface chemistry.

The measurement methods, standards, and data produced in this program are needed for the safe handling of potentially hazardous chemical materials; for the development of laser and other weapons for defense; for the design of more energy efficient processes; for energy conservation in industrial plants; and for reasonable regulations and demonstration of compliance. The outputs of this program also provide the scientific foundation for important industrial processes. For example, evaluated data are provided to design engineers and the research community. Thousands of scientists and engineers in the chemical/petroleum industries use these data daily. This program's output saves these organizations millions of dollars per year in the acquisition of numerical values. In addition, research producivity is known to increase by as much as 10 percent by the provision of efficient access to evaluated technical information. New calibration data and standard techniques from this program reduce industry calibration costs by $6 million per year by reducing the number of hours required for each calibration.

Based on the scientific and technical capability developed under this program, NBS also is able to respond, on a reimbursable basis, to the research and development requirements to various private sector organizations and other Federal agencies. For example, the American Institute of Chemical Engineers requested NBS to assist them in calculating properties data of industrial solutions for inclusion in an upcoming chemical engineering handbook. The Department of Energy (DOE) and the Department of Transportation (DOT) have utilized NBS expertise in chemical physics to evaluate parameters associated with the hazard potential of chemical systems arising from explosion, fire, and chemical reactivity. DOE has also called upon NBS to apply its capability in the kinetics of aromatic compounds to the evaluation of the incinerability of hazardous chemicals. This research is needed to assist DOE and industry in the design of environmentally acceptable hazardous waste incinerators.

Recent accomplishments include the following:

Improvement of the accuracy of measurements of the sputtering yields for selected pure elements using low-energy ions as a basis for improving quantitative measurements of elemen-

tal composition versus depth needed to predict materials performance.

Relation of the heats of formation of nucleic acid fragments to measured heats of combustion and solution. This will provide basic thermodynamic data needed by emerging biotechnology industries to determine reaction pathways and the feasibility of new biochemical processing techniques.

Application of the heated, single-pulse shock tube to the study of resonance-stabilized free radicals to provide fundamental chemical kinetics data. These data are used to determine reaction paths and affect the design of industrial processing methods using alternate fuels.

Development of theoretical models for predicting the interaction energies and reaction pathways of complex organic molecules. This information is needed by the private sector in order to improve the efficiency and effectiveness of industrial chemical processes.

Planned accomplishments in fiscal year 1985 include the following:

Determine the microscopic structure of layers of water on metal surfaces, and the structural and chemical influences of trace impurities on the water. The results will be used to model catalyst poisoning or promotion actions.

Use the new chemical theory of graphite to explain the reactions of gases with solid carbon containing surfaces in order to provide information needed to model environmental and industrial processes.

Demonstate the utility of heat release measurements to monitor conformational changes in model proteins and other biopolymers.

Complete spectral analysis of hydrogen fluoride dimers, and continue high-resolution spectroscopic studies of other hydrogen-bonded molecules. These precision measurements and analyses will provide basic molecular properties needed by the chemical physics community to advance understanding of biomolecules and aqueous systems.

BIOTECHNOLOGY INITIATIVE..... $3,000,000

The budget level in the bill for the Chemical Properties and Processes Program includes an increase of $3,000,000 and 28 positions to develop a scientific basis for the use of biotechnology in chemical production and related industries. This research program will decrease scientific and technological barriers to the industrial use of biotechnology caused by the lack of understanding of three major chemical problems: (1) the effective use of biomolecules in the production of chemicals; (2) separation processes applicable to mixtures of biomolecules; and (3) the use of biomolecules in chemical analysis, process monitoring, and control.

Biotechnology is changing the chemical and allied industries. Current forecasts on the global market for biotechnology-based products are in the range of $23 to $200 billion by the year 2000. The first major sector affected by biotechnology has been the pharmaceutical industry. By 1990, the pharmaceutical market for biotechnology-based products alone will reach $2 to $3 billion. Biotech-

nology-based products and processes, however, are expanding into other sectors—foods, agriculture, and specialty and commodity chemicals. Over 250 companies are already involved in the industrialization of biotechnology, with every major chemical company now having a substantial investment in biotechnology. These companies, large and small, cannot develop broad chemical data bases, predictive capabilities, or escape the trial and error approach to development on their own. This program will provide the generic data bases and models needed by industry to more quickly and efficiently develop process optimization strategies, tailor reaction conditions, and use biomolecular starting materials.

The number of commercial processes incorporating biotechnologies is expected to increase dramatically as industry responds to external forces and exploits the inherent advantages of the new methods of bioprocessing. The United States petrochemical industry faces three major long-term challenges: (1) competition from new foreign producers of chemicals who have ready access to presently wasted or low-priced feedstocks; (2) higher prices for domestic petroleum and natural gas feedstocks, making U.S. chemicals less competitive internationally; and (3) long-range decreased availability of petroleum feedstocks, either because of foreign political decisions to support their own chemical industries or global depletion of petroleum reserves. To counter these pressures, the chemical industry must search for more efficient chemical processes, shift processes to produce higher value added products, or find ways to utilize cheaper domestic feedstocks such as biomass. Biotechnology provides promising routes to all these alternatives. Current annual production of organic chemicals is close to 100 million metric tons. Many of these chemicals could be produced by microbial fermentation with or without chemical processing. These chemicals and their derivatives represent nearly half the total organic chemical production, and their value is over $15 billion. Ethyl alcohol produced by fermentation is already cost-competitive with that obtained from ethylene.

The potential impact of biotechnology can be seen in the commercial success of biocatalyst (enzyme) technology in the production of high-fructose corn syrup (HFCS), a sweetener widely used in foodstuffs. In this process glucose produced by the enzymatic hydrolysis of corn starch is converted by another enzyme to fructose, which is sweeter than glucose. The resulting mixture of glucose and fructose, HFCS, is about as sweet as an equivalent amount of sucrose from sugar cane or beets. The process became commercially profitable in 1974, following a large rise in sugar prices. Even when sugar prices dropped two years later, the process was firmly established and has expanded since. In 1980 more than one million tons of HFCS were produced in the United States, with production expected to double by 1985. Further improvements in this process, however, will depend on improvements in the chemical database for glucose and fructose. Data base improvements are expected from proposed NBS research in this area.

This initiative will provide the research necessary to meet the measurement needs of the chemical production and related industries as they introduce biochemical processing methods. This program will develop the experimental and theoretical basis to meas-

ure biomolecules accurately and to control their chemical activity. Techniques will be developed to separate, detect, and accurately, measure biomolecules in the complex mixtures in which they are found or used. Research will be conducted to develop an understanding of the properties and chemical activity of biomolecules. This research is necessary to construct predictive models that can be used by industry for process optimization, for improved analytical techniques and quality control, and for the selection, design, and optimization of biocatalysts.

The NBS program will facilitate selection and introduction of new or improved industrial processes and chemicals into the marketplace, thus contributing to the international competitiveness of the Nation's chemistry-based industries. The program will support implementation of alternate energy technologies (biomass conversion) and waste utilization strategies (recycling of waste streams).

MEASUREMENT TECHNOLOGY TRANSFER..... $4,545,000

The programs described in this section are the primary means by which NBS transfers its developed measurement techniques, standards and data to industry, universities, and government.

The Standard Reference Data (SRD) program provides scientists and engineers with critically evaluated physical and chemical data needed for solving problems in research, development, and engineering design. The work is carried out in several data evaluation centers located within NBS and in other institutions. These centers collect all reported measurements on materials and processes of interest, subject the chemical and physical data to expert critical evaluation and analysis, develop appropriate models to predict the properties of substances that have not been measured, test the predictions with additional measurements, and produce compilations of data suitable for general industrial, scientific and engineering use. The Standard Reference Data Program publishes about 5,000 pages of evaluated data annually, covering typically 40 to 50 different subjects. Computer readable databases are also being produced. The raw material for these tables and databases consists of the 30,000 or more original reports and research papers from all parts of the world that are collected and analyzed each year. This aggregate collection is also used to answer the hundreds of requests for specific data that are addressed to NBS every year.

The evaluated data outputs developed under the Standard Reference Data Program are used by other government agencies and industry on a reimbursable basis. For example, evaluated data on the solubility of organic compounds derived from coal are used by the Department of Energy (DOE) to develop reliable theoretical prediction models that can aid in the design and development of more effective and efficient energy systems to use our Nation's most abundant resource, coal. A comprehensive state-of-the-art database for the thermodynamic properties of ethylene, an important feedstock for the chemical and petrochemical industry, was requested by the DOE so that applicable industries could design and develop more efficient plant processes.

Standard Reference Materials (SRM) have been produced, certified, and issued by NBS since 1906. They provide benchmarks for calibration of instruments and measurement systems. SRM's help

industrialists and technologists make effective use of materials through improved quality control over the production of goods. They also help assure equity in buyer-seller transactions, and assure the long-term adequacy and integrity of the measurement process.

In fiscal year 1985, $400,000 will be transferred to the NBS Working Capital Fund (WCF) to capitalize research and developmental costs associated with specific SRM's so that a larger part of the costs can be recovered through sales. This is in addition to the production and certification costs of SRM's that are currently capitalized and recovered through sales. The sale prices of SRM's will be raised to reflect the higher portion of capitalized research and development costs. Since an average production batch of SRM's results in a five-year inventory, the amount capitalized will not be entirely recovered through sales until the fifth year of sales, or seven years after the initial investment. Continued appropriations for transfer to the WCF through fiscal year 1988 will be required to complement sales income so that the level of capitalized research costs can be continued at $500,000 per year, as shown below.

WORKING CAPITAL FUND TRANSFERS FOR CAPITALIZING SRM R&D COSTS

[Dollars in thousands]

	1983	1984	1985	1986	1987	1988	1989
New Increment Transferred	$500	$500	$400	$300	$200	$100	.....
Increase in Sales Revenue			100	200	300	400	$500
Total	500	500	500	500	500	500	500
Increment of Reduced Approp			100	100	100	100	100

This transfer to the WCF results in a $100,000 decrease in requirements for appropriated funds for fiscal year 1985. By fiscal year 1989, the appropriation will have been reduced by a total of $500,000.

In planning and producing SRM's, NBS draws upon the technical competence and measurement technology expertise developed in all STRS programs and relies on close interaction with U.S. industry for guidance. Production and administrative costs are recovered through the sale of more than 900 different SRM's including metals, glass, rubber, plastics, chemicals, nuclear materials and standards for evaluating the performance of computer and electronic systems.

The Measurement Assurance Program (MAP) and National Voluntary Laboratory Accreditation Program (NVLAP) provides services to ensure measurement quality in commercial and government calibration and standards laboratories. Basic measurements, statistical capabilities and transfer standards have been developed for MAP's for quantities such as mass, voltage, capacitance, microwave power, temperature, and X-ray dosage. For NVLAP, NBS develops performance criteria, establishes examination methodology, qualifies examiners, conducts workshops, and makes recommendations for accreditation to the Secretary of Commerce. Accredited laboratories provide assurance that products, including materials, components, and systems, meet the criteria stated in engineering and

product standards. The Measurement Assurance Program and the National Voluntary Laboratory Accreditation Program are proposed for conversion to full cost recovery in fiscal year 1985.

Recent accomplishments include the following:

Publication of a new edition of the Joint Army/Navy/Air Force Thermochemical Tables, the most widely used source of such data for industrial and military applications.

Development of a computerized database of physical and thermodynamic properties of organic compounds for use in chemical process design.

Completion of a new series of low level radioactive natural matrix (lung tissue and soil) SRM's for use in monitoring nuclear power reactor sites.

Development of a series of new measurement methods involving several techniques including isotope dilution mass spectrometry and neutron activation analysis. These techniques are used to analyze trace-level impurity gases in high technology metal SRM's including specialty stainless steels, nickel-based alloys, zirconium alloys, and titanium alloys.

Development of the first SRM's for use in accurately determining the heating value of coals.

Development of an optical retroreflectance MAP for consumer product evaluation (road signs, bicycle reflectors).

Development of a microwave power MAP for defense and aerospace applications.

Planned accomplishments in fiscal year 1985 include the following:

Develop new analytical methods for accurately determining the concentrations of gases such as nitrogen, hydrogen and oxygen in metals used in aerospace applications.

Develop a special reference material package for neutron dosimetry of fast neutrons in nuclear reactors. Such a package will contribute substantially to safe reactor operation by aiding accurate neutron exposure surveillance.

Publish a compilation of data on the crystal structure of metals, designed for use in selecting and identifying materials.

Release computerized databases of infrared spectra for identification of unknown chemicals and X-ray absorption constants needed for design of shielding against ionizing radiation.

Complete development of an X-ray dosimetry MAP for medical application.

APPLIED MEASUREMENT PROGRAMS $2,175,000

This program is concerned with the development and operation of multi-disciplinary activities that require the use of a wide range of NBS technical resources in order to respond to specific national needs and to the long-term needs of industry. Efforts in this program are currently focused on strengthening the ability of U.S. industry to utilize Nondestructive Evaluation (NDE) measurement methodology for improving production line process control and in-service inspection procedures.

Nondestructive evaluation is the process of determining the quality of a part or an assembly without damaging it. U.S. industry is increasing its use of NDE in the manufacturing process to improve

product quality control and to identify defective components early enough in the production sequence to avoid further costly processing. It is also used extensively to detect incipient flaws and prevent catastrophic failure of in-service structures such as bridges, airplanes, pipelines, and power plants.

The NDE program provides the required underlying science, reference measurement methods, measurement standards, and calibration services for the nondestructive evaluation methods most widely used by industry for detecting and characterizing flaws in materials, structures, components, and manufactured products. If undetected, these flaws could lead to premature failure. Examples of these methods and their use include: ultrasonic testing for inspection of electric power generation components and systems; X-ray radiography for inspection of oil and gas pipeline welds; eddy current testing for process control of electrical filament wire, and for inspection of aircraft components and steam generator tubing; penetrant diagnostics for flaw detection in pumps and valves; and magnetic particle testing for inspection of wrought steel products. The program also develops standards and measurement services that will speed the adoption of new or improved NDE methods that offer enhanced quality assurance capabilities. Some of the new methods being addressed include: acoustic emission testing for continuous monitoring of production line welding and in-service monitoring of such structures as bridges and pressure vessels; small angle neutron scattering for monitoring metal hardening processes and fatigue damage in high strength metals; and advanced X-ray diffraction techniques for determining internal residual stresses in metal components.

The development of new and improved measurement methods and standards by NBS will promote more reliable product quality control during production, conserve materials, increase the safety and reliability of in-service products, and increase the Nation's productivity. Product failures resulting from defects introduced during processing or manufacturing may be greatly reduced by eliminating defective materials before they are used to fabricate components, and by testing components and products before they are sold and placed into service. This requires a quality assurance technology that is capable of economically assessing the condition of materials and determining whether they are suitable for their intended applications. In addition, the extended use of NDE techniques throughout industry for defect detection requires greater reliability and comparability of test methods.

As a result of these ongoing activities, NBS has developed a unique competence in both assessing the quantitative capabilities of various nondestructive evaluation techniques and developing new or improved techniques. The same experimental and theoretical competences developed for these NBS activities are being applied to specific work for other government agencies. For example: x-ray radiography techniques are being evaluated for the U.S. Navy for use in checking missile motors; specifications documents are being prepared for the U.S. Army that describe recommended practice for utilizing various nondestructive evaluation methods; and methods to test for very small leaks in vessels are being developed for the Department of Energy (DOE).

Recent accomplishments include the following:

Use of small angle neutron scattering as a reference measurement method to evaluate distributed damage (many small flaws) in materials. The validity of conventional NDE techniques may now be assessed for field measurement purposes.

Completion of research for stable metal alloys needed to increase the range of NBS conductivity standards for eddy current testing.

Development of NBS reference transfer standards for acoustic emission and ultrasonic testing.

Development of prototype reference materials for standardizing measurements of high radiographic densities.

Planned accomplishments in fiscal year 1985 include the following:

Establish relationships between machine tool wear and acoustic emission parameters.

Develop a computer-aided analysis methodology for assessing the reliability of ultrasonic and radiographic NDE applied to pressure vessel welds.

Correlate ultrasonic, X-ray and neutron diffraction techniques for evaluating residual stresses in the interior of metallic components.

Develop NDE techniques for characterizing the quality of unfired ceramic components.

2. ENGINEERING MEASUREMENTS AND STANDARDS (Sec. 201(a)(2)..... $23,194,000

This activity includes research and development work on Engineering Standards, on Safety and Performance Engineering, Technical Support to Industrial Productivity, and research in the Mathematical Sciences. A description of the activities in each subcategory follows.

BUILDING RESEARCH..... $3,969,000

This program carries out activities that remove technological market barriers and improve safety of the building construction industry including conducting field, laboratory, and analytical research on the performance of building materials and structural components and systems. This research results in the development of, for example, (1) instrumentation and techniques for the measurement of loads and the associated structural response of buildings; (2) mathematical models for predicting the time dependent response such as acceleration, velocity, displacement, and stress of building structures and components to static and dynamic loads; (3) methods to characterize the response of masonry structures under earthquake-type loading; (4) an analytical model for the effects of temperature and time on strength gain of concrete; (5) measurement methods to determine the shear strength and plastic limit of soil; (6) a probability-based method for prediction of the service life of building materials; and (7) mathematical models of building controls systems that predict the dynamic operation of heating and cooling equipment. This program benefits building owners, occupants, and the construction industry by (1) investigating major building and construction disasters (e.g. the walkway collapse in the Kansas City Hyatt Regency in 1981 and East Chicago, Indiana

highway ramp collapse in 1982); (2) providing expertise and support to Federal agencies with building concerns (e.g. Occupational Safety and Health Administration (OSHA), General Services Administration (GSA), Federal Emergencies Management Agency (FEMA), and the White House); and (3) providing nonproprietary technical information for the development of voluntary standards for buildings by organizations such as the American Society for Testing and Materials, American Concrete Institute, American Society of Heating, Refrigerating, and Air Conditioning Engineers, and model building code organizations. In response to the National Earthquake Hazards Reduction Act, this program provides the laboratory research for the development of seismic design and construction provisions. (NBS has directly supported earthquake related research within its appropriation at an annual level of $475,000.) Quality assurance also is provided for 580 public and private laboratories nationwide that are relied upon by owners, designers, builders, and state and local governments for measurements of the properties of materials for buildings and transportation facilities. Private sector R&D and innovation are stimulated by this program's development of authoritative, non-prescriptive measures for building materials and structural components (i.e. measures based on performance rather than fabrication process). Lastly, international activities include interacting with peer organizations in all developed and most underdeveloped countries in cooperative programs of building research and representing the U.S. building community in international building standards activities to assure the international competitivenes of U.S. construction products and services.

This program's results are used to improve Federal, state, and local government codes and specifications which lead to: (1) reduced cost of buildings; (2) assurance that cost effective, innovative materials and structural components deliver their intended service lives; (3) greater building reliability and durability; and (4) reduced losses from high winds and earthquakes.

The basic scientific capabilities developed under this program have also enabled NBS to respond to the needs of other Government agencies and the private sector on a reimbursable basis. For example, in response to the National Earthquake Hazards Reduction Act, NBS has assisted the Federal Emergency Management Agency in improving the design standards for both public and private sector buildings. DOE has funded NBS to develop measurement techniques for evaluating the energy savings of retrofit options for residential structures. Results using these techniques demonstrated that space heating fuel consumption could be reduced by 41 percent when modifying a typical house built before the 1970's at an average cost of less than $2,000. NBS developed an advanced guarded-hot-plate in response to the Federal Trade Commission's request for precision measurement of the thermal conductivity of thick insulation. The U.S. Chamber of Commerce reports that this development now saves the consumer 90 million dollars a year by eliminating the use of excess insulation. NBS was requested to do this work because of its unique research facilities, recognized technical expertise and impartiality.

Recent accomplishments include the following:

Establishment of a means that provided interfaces between engineering standards and computer-aided building design programs to provide interchangeability and updating of the standards. Computer-aided design is a key element in increasing construction productivity.

Development of probability-based load criteria for the safe and economical design of non-load bearing curtain walls subjected to environmental loads such as wind, rain, and ice. Curtain wall failures have increased from 15 percent of all building failure claims in 1960 to 33 percent in 1980.

Establishment of the effect of thermal mass on the heating and cooling loads in buildings. Thermal mass effects have a direct impact on energy conservation.

Development of stochastic model for predicting the degradation of polymeric building materials taking into account the combined effects of ultraviolet light, heat, and moisture. This model will allow for the selection of durable materials, hence, reducing life-cycle costs of the building.

Planned accomplishments in fiscal year 1985 include the following:

Verify experimentally a mathematical model for predicting the rates of degradation of corrosion-protective coatings on steel. Annual losses due to corrosion of steel structures exceed $70 billion.

Measure the performance of energy management and control procedures and systems. Improved performance can reduce the cost of automated building control systems by 40 percent.

Evaluate experimentally mathematical models for simultaneous heat and mass transfer in refrigerant systems. This work will provide the U.S. refrigeration industry with fundamental heat transfer data for developing more efficient refrigeration systems.

Produce a validated computer program for predicting the thermal performance of multi-room buildings. Use of improved thermal modeling techniques in buildings can result in a 30 to 50 percent decrease in energy usage.

Develop techniques for the identification of structural damage through changes in the response of the building structure. Accurate assessment of structural integrity will reduce the repair costs associated with damage caused by winds, earthquakes, and other extreme loads.

SIGNALS AND SYSTEMS METROLOGY..... $6,110,000

This program provides national reference standards, measurement methods, supporting data and traceability of measurements to national standards for removal of market barriers (e.g. technical disagreement between buyer and seller associated with measurement of performance) in areas of fast signal acquisition, processing, and transmission; electrical power systems; and electromagnetic interference. Activities include: (1) advancing basic measurement science to enable accurate measurement of such electrical parameters as voltage, current, electric field, magnetic field, and power; optical fiber bandwidth, attenuation, and core diameter; and laser power and energy; (2) developing measurement methods for electrical

quantities such as power, high voltage, high current, microwave parameters, and electromagnetic field parameters, and for electrical systems such as antennas and digital electronics; and (3) providing the technical and scientific information for the development of voluntary or de facto standards.

Signals and systems metrology serves nearly the entire electronics industry and directly affects a large portion of our society. For example, the calibration of every watt-hour meter in every home and company in the United States is traceable to standards developed by this program. Equity and efficiency in commerce as well as quality in manufacturing electronic systems such as microwave equipment, lasers, antennas, and optical fibers are facilitated by standards, measurement methods, and measurement services based on advances in measurement science achieved in this program.

The rapidly growing satellite-communication and optical-fiber industries utilize measurement methods developed and evaluated in this program. Such forefront-technology industries require highly advanced measurement methods relating industrial measurements to national standards delivered in a timely manner for the efficient conduct of commerce. NBS research on measurements at the limits of speed, sensitivity, and accuracy supports U.S. industry in computers and telecommunications—areas in which U.S. industry is experiencing severe international competition.

Private sector and Government development of safety standards for microwave equipment, including communications systems and appliances, and for laser systems used in industrial, commercial, and military applications requires measurement methods and physical standards developed in this program.

The technical expertise developed in this program enables NBS to provide services on a reimbursable basis to the private sector and to other government agencies. For example, during fiscal year 1983 calibration services were provided to 200 organizations, including nearly all major high-technology companies and all Federal agencies employing advanced electronic systems. Further, with DOD support, NBS has developed the first national physical standard for noise in a critical segment of the millimeter-wave domain (i.e. 30 to 300 GHz) of the frequency spectrum. The standard will aid in expanding the use of the millimeter-wave systems for communications, defense, and aerospace applications. NBS assistance in these areas is sought by industry and Government because NBS' special metrological capabilities and neutral posture enable ready acceptance of its methods for performance assessment in market transactions.

Recent accomplishments include the following:

Completion of a standard waveform generator capable of producing selected waveforms with an accuracy of 500 parts per million over the frequency range of 10 hertz to 20 kilohertz. This standard is required for calibration of diverse automated electronic instrumentation and test equipment used in manufacturing and in the maintenance of high-technology systems.

Development of techniques to increase the dynamic range of attenuation and reflection coefficient measurements with the 6-port microwave measurement system to 80 decibles. This new capability is required for performance assessment of the ultra-

sensitive microwave satellite-communications receivers now appearing in the marketplace.

Extension of the NBS optical-fiber measurement capability to second-generation fiber systems operating at longer wavelengths. This capability will enable equitable sale of new, high-performance fiber systems which are now the subject of intensifying international competition for a multi-billion dollar market.

Completion of electric and magnetic field probes for the 1 to 100 megahertz range. The probes will provide the generic basis for an important element of the industrial effort aimed at resolving the threats posed by electromagnetic interference to the functioning and sale of high-technology electronic systems.

Planned accomplishments for fiscal year 1985 include the following:

Develop outdoor measurement techniques for the electromagnetic emissions from electronic equipment, in the range 10 kilohertz to 500 megahertz. This measurement capability will be used by industry in developing electronic equipment which can comply with national and international regulations on electromagnetic interference.

Develop an optical detector system capable of measuring short optical pulses of 25-picosecond duration. This capability will enable development of measurement methods required for performance characterization of advanced single-mode optical fiber systems used in communications, radar, and navigation systems.

Complete a first 6-port measurement system for use in quality control and performance assurance for millimeter wave systems. Millimeter wave systems for communications and radar are growing rapidly in significance for both commercial and Government applications.

Develop an extended near-field antenna-measurement theory as a common basis for measurement of larger antennas on existing far-field ranges. This capability will enable manufacturers and buyers of antennas to evaluate complex new high-performance satellite-communications antennas previously too large for evaluation on far-field ranges.

CHEMICAL ENGINEERING METROLOGY $4,352,000

This program provides the underlying scientific basis and chemical engineering measurement techniques, standards, key properties data, and predictive methods to enable the chemical and related industries to calibrate their measurements relative to national standards for equitable exchange of goods in commerce and to efficiently design processes and plants.

This program develops accurate measurement techniques, traceable to NBS standards, for flow rate, volume and density. These techniques are used by U.S. industries (e.g. chemical, petroleum, utilities, beverage, etc.) and state governments to assure that goods transferred in commerce are accurately measured.

The data portion of this program places emphasis on the development of critical thermophysical properties data and predictive models that allow interpolation between measured data points. The

chemical industries use these data for efficient process and plant design.

The measurement portion of this program places emphasis on the development of new flow measurement techniques for mixtures of solids and fluids, and on other critical process measurements such as composition, temperature, viscosity, and density of the flow stream. Special emphasis is being given to industrial measurements which are made in harsh environments, e.g., at high temperatures and pressures. In addition, this program is developing measurement services and techniques for measurements of liquids and gases needed for diverse process control and equity in trade. Improved predictive methods for heat and mass transfer in chemical reactions are also being developed. These results are essential to support the increasing use of feedstocks derived from the heavier fractions of crude oils and solids such as coal, biomass, tar sands, and shale.

The U.S. chemical process industries have annual sales exceeding $160 billion and constitute an important component in the international balance of trade. However, the U.S. share of world trade of chemical products has dropped from 20 percent to 14 percent in the last decade. This sector of U.S. industry spends about 10 percent of its annual gross sales on capital investments. The improved data, measurements and predictive techniques provided by this program will enable industry to reduce capital costs for new equipment and plants, save raw materials and reduce product energy requirements for new and existing plants, reduce waste products and environmental pollution, and provide improved equity in the marketplace. Industry estimates that savings in excess of $7 billion per year would result from the provision of an adequate generic database for thermophysical properties. While the total savings are high, the savings for any one company are not large enough to justify industry's investment in developing these data.

The basic scientific capabilities developed under the STRS program enabled NBS to provide reimbursable services to other Government agencies and the private sector. For example, the program performs calibrations of volume, density, humidity, and liquid and gaseous flowrate for the chemical proces industry and for state governments. With support from the American Petroleum Institute, NBS has provided basic metering data to national and international standards organizations for the development of standards for liquid flow measurement. NBS was requested to perform these services to assure traceability of measurements to national standards that are required for domestic and international equity in trade of natural and commercial gases and liquids such as petroleum, gasoline and beverages.

Recent accomplishments include the following:

Development of measurement methods for industrial chemical mixers that established a scientific basis for mixer performance standards. This provided standardized test procedures and will result in improved performance specifications, more efficient design criteria and lower energy costs.

Perfection of a new acoustic measurement technique to determine thermophysical properties of industrially important

gases and to significantly improve the internationally accepted value of the universal gas constant.

Planned accomplishments in fiscal year 1985 include the following:

Development of a multiangle scanning laser absorption technique to provide temporal and spatial measurement of composition and temperature in a chemically reacting system such as a combustor in order to establish a basis for optimizing these reactions.

Develop and publish a wide-ranging computer model to calculate vapor and liquid phase equilibria properties of complex fluid mixtures of industrial importance such as hydrogen sulfide, alcohols, ethylene, carbon monoxide, methane, propane, isobutane, hydrogen, oxygen, etc. This model will improve innovation, design, and operation of higher value-added chemical processes.

Develop recommended measurement practices and publish characterization criteria for liquid and polymeric membrane separations. Industry will use these data and techniques for separating desired products from chemical process streams.

Develop and test a microsecond pulse calorimeter as a unique new technique to measure the thermal properties of high melting point materials such as molybdenum, tungsten, graphite and other metals used throughout U.S. industry (e.g., chemical and nuclear reactors, combustion, and power equipment, aircraft and space vehicles, etc).

Develop and publish recommended procedures for measuring thermal properties (e.g., heat capacities and thermal conductivity) of coal. This will enable industry and universities to generate reliable design data for the use of coal as feedstocks to produce chemicals or synthetic fuels.

ENGINEERING AND PRODUCT STANDARDS $3,253,000

This program formulates and implements policy guidelines related to national and international standardization and legal metrology. The program also coordinates with domestic, foreign, and international treaty and non-treaty organizations concerned with standardization and related measurement activities.

First, the program addresses Departmental responsibilities for implementing the Trade Agreements Act of 1979, concentrating on standards that constitute unnecessary technical barriers to trade, such as different foreign national standards for the same product instead of a single internationally accepted standard. U.S. industry requires rapid and accurate information on foreign standards, certification requirements, and proposed regulations in order to establish competitive positions in the markets of other countries. Efficiency of U.S. production, competition, and product distribution depends on accurate, quick-response information on domestic and international standards and related activities. To provide for these needs, the program operates the National Center for Standards and Certification Information, which responds to approximately 7,000 inquiries annually from business (50 percent), governmental agencies (30 percent), consumers, students, and others (20 percent). The Center uses a unique reference collection consisting of more than

26,000 standards and specifications issued by the U.S., foreign, regional, and international standards-writing organizations.

Second, the program provides overall management, planning, policy development, impact analysis, and coordination of the Department's involvement with engineering standards and information: coordinates standards policy, especially with respect to voluntary standards, among Federal agencies: and advises management on the resolution of standards issues. The Standards Assistance and Management Information activity develops data on participation by NBS staff members in domestic and international standards committees. The program also administers Departmental responsibilities associated with OMB Circular A-119, which encourages effective participation by agencies in the private sector standards community in order to satisfy Government needs for standards that may be used in purchasing and regulation. This includes development of procedures and practices for full implementation of OMB Circular A-119.

In addition, the program supports the legal metrology (i.e., weights and measures) system of the United States domestically and internationally, by providing the required measurement technology to the States. In fiscal year 1984, NBS issued a second grant as well as provided technical assistance to the National Conference of Weights and Measures for the continued development of a national training program. This training program will be used by state and local governments primary instruction in weights and measures regulation and inspection. Other activities include administering the National Conference of Weights and Measures; providing traceability of state measurement standards to the national standards at NBS; and promoting uniformity through model laws, regulations, and standards. The program is also responsible for conducting the meetings of U.S. working groups of the International Organization of Legal Metrology (OIML) to draft international recommendations covering instruments used in commerce and presenting these recommendations at meetings of OIML. The essence of the domestic activity is to assure industry and the public that the weights and measures used are uniform and accurate, with traceability to national standards, while OIML activity seeks to keep foreign markets accessible to U.S. device producers.

Recent accomplishments include the following:

Completion of a design and pilot testing of a quick retrieval information system to handle data inquiries concerning standards and certification programs.

Completion of the organizational phase of a "National Type Evaluation Program" for the uniform acceptance of weights and measures devices on a national basis.

Adoption of recommended guidelines concerning standards development and certification by the Interagency Committee on Standards Policy as mandated by OMB Circular A-119.

Planned accomplishments in fiscal year 1985 include the following:

Begin operation of an information system on foreign certification programs to aid U.S. exporters in gaining acceptance of their products in foreign countries.

Issue first certificates to the manufacturers of weights and measures devices in the implementation of the "National Type Evaluation Program."

Gain OIML acceptance of the U.S. proposal for decentralized bilateral agreements on international certification.

Prepare report for OMB on the status of implementating Circular A-119 by Federal agencies.

MATHEMATICAL SCIENCES $5,510,000

This program ensures that the most appropriate mathematical, operations research, computational, and statistical procedures are available for use in NBS technical programs. This program develops widely used mathematical methods in such areas as: mathematical modeling, nonlinear mathematics, computational techniques, graphics for analysis of complex data, symbolic manipulation and nonnumerical processing, discrete mathematical models, linear programming, network optimization, statistical experiment design, robust statistical methods, statistical modeling, time series analysis, and statistical control of measurement processes. In addition, this program provides advice and assistance to scientists and engineers at NBS by acquiring, adapting, developing, testing, evaluating, and documenting scientific computing software packages and assisting in their use in NBS research programs.

The Mathematical Sciences program has substantial impact on both the efficiency and productivity of all NBS programs as well as the quality of their output. This is achieved by making available analytical, statistical, operations research, and scientific computing tools which are common to the needs of different NBS programs, and by collaborating with NBS physical scientists and engineers in applying specialized mathematical techniques. Readily accessible mathematical and computing assistance enables bench scientists to focus more fully on their own specialties. NBS mathematicians, maintaining an understanding of the Bureau's work, are in a position to draw from the literature and from mathematicians at other organizations the mathematical methods that will most effectively serve the needs of individual programs. In addition, direct involvement with Bureau programs allows NBS mathematicians and statisticians to recognize needs common to many application areas and to develop or adapt tools or methods to meet these needs.

Based upon this program's expertise in statistical sampling of materials, NBS has been able to provide reimbursable services for the National Archives and Records Service. For example, this program planned and analyzed a survey of the physical condition of textual holdings, and recommended an inspection strategy for distributing the most urgent preservation workload to documents whose survival is at risk. In addition, this program's expertise in the management of technical databases has been used to assist the U.S. Army Corps of Engineers Coastal Engineering Research Center with a plan for indexing and compression of its extensive holdings of beach-erosion data. By selecting NBS to perform these services, the requesting organizations avoid a conflict of interest.

Recent accomplishments include the following:

Development of improved relational database structures, for example, in recording and graphically reproducing metal-alloy

phase diagrams. This allows data sets to be transmitted among laboratories from a central data bank with the form of the data items explicitly machine-readable.

Development of statistical methods for examining sources of systematic error in precision measurements. These methods are required, for example, to assure temperature transfer accuracy in the low temperature range to high technology laboratories using cryogenic equipment.

Publication of a handbook (co-authored with a Canadian laboratory) on statistical methods for certification of reference materials.

Acquisition and development of software for an interactive graphics system. This system will greatly enhance mathematical model evaluation and understanding by providing scientific computing users with necessary graphics services for improved data analysis and display.

Planned accomplishments in fiscal year 1985 include the following:

Extend mathematical modeling for directional solidification with solute segregation at the liquid-solid interface, a generic problem encountered in the formation of binary metal alloys and in processing impurity-doped semiconductors.

Apply advanced graphics techniques for visualizing complex 3–D motions and configurations in physical phenomena; for example, to clarify the vibration modes of polymer molecules near defects, and to display the molecular dynamics of partially ordered fluids.

Develop stochastic modeling techniques for corrosion and failure effects in electrochemically active materials.

Provide software development and access methods for the vector or parallel processing of special large-scale problems on appropriate large computing systems. Examples are the development of a vectorized 3–D room-fire model for solution on the Cyber 205, and the development of vectorized particle simulation method for molecular dynamics.

TECHNICAL REIMBURSABLE SERVICES..... NONE

This program is totally supported on a reimbursable basis and includes funding for the NBS Office of Energy Related Inventions (OERI) and the NBS Law Enforcement Standards Laboratory (LESL). OERI was established within NBS under the terms of Section 14 of the Federal Nonnuclear Energy Research and Development Act of 1974. OERI, which receives funds from DOE, is responsible for evaluation of energy related inventions, particularly those submitted by individual inventors and small companies. OERI is also responsible for outreach activities aimed at bringing the program to the attention of inventors and small businesses. The evaluations, which are performed by NBS staff and outside consultants, are based on three general criteria: technical feasibility, potential energy-conservation or supply impact, and commercial feasibility. Inventors are notified of the results of the evaluation in each case.

The primary mission of LESL is to develop performance standards to assist state and local governments in the cost-effective procurement of equipment suitable for the needs of law enforcement

agencies. In addition to conducting research and developing technical guidelines for law enforcement equipment, LESL also issues technical research reports and data of a tutorial nature to assist personnel in the selection and application of specific equipment. Funding for these activities are provided by the Departments of Justice and Transportation and the Defense Nuclear Agency. These agencies rely on the scientific and engineering expertise of NBS to address problems of the criminal justice system and public safety.

A number of accomplishments were recently achieved in this program. For example, the Office of Energy-Related Inventions (OERI) provided approximately 1,000 evaluation reports to inventors in fiscal year 1983. OERI also sponsored four regional innovation workshops and provided support to the National Congress of Inventor Organizations. As requested by the National Highway Traffic Safety Administration (NHTSA), the Law Enforcement Standards Laboratory (LESL) completed a limited laboratory study to determine the extent to which evidential breath testers (EBT's) are interfered with by fields transmitted from mobile and handheld police communications systems. The results of this study were published by the NHTSA to assist State and local governments in avoiding potential electromagnetic interference problems with EBT's. The EBT's are widely used in local alcohol countermeasure programs to combat drunken driving. In addition, LESL completed the development of nine voluntary national standards for police equipment for publication by the National Institutes of Justice, and a report on the incapacitation effects of handgun ammunition, which will assist State and local governments in the selection of service ammunition.

3. COMPUTER SCIENCE AND TECHNOLOGY (Sec. 201(a)(3))..... $10,000,000

The goals of this activity are to develop, issue, and maintain for the Federal Government, standards and guidelines needed to achieve (1) technically sound international standards that will preserve the competitive options of the American automated data processing (ADP) industry; (2) the increased productivity of both the Federal and private sector work force; (3) the reduction of waste, error, and unnecessary duplication in the application of computer systems; (4) the competitive and economic procurement of Federal computer systems, components, and services; (5) life-cycle efficiency and effectiveness of Federal computer resource utilization; (6) portability of data, software and technical skills across computer systems; and (7) protection of computer systems and networks against unauthorized access, manipulation, or abuse.

The specific objectives are to:

Coordinate with and support domestic voluntary standards-making organizations to ensure that the development of standards is timely, efficient, and compatible with industry.

Monitor and provide technical support for developments in international standards-making organizations.

Establish close communications with Federal agencies to determine need for Federal standards and guidelines.

Advise the Secretary of Commerce, the General Services Administration (GSA), and the Office of Management and Budget

(OMB) on the establishment of policies and procedures for Federal agencies to request waiver of mandatory standards.

This program is conducted by the Institute for Computer Sciences and Technology (ICST) under several authorities. The Brooks Act (P.L. 89–306) provides for the economic and efficient purchase, lease, maintenance, operation and utilization of ADP equipment by Federal agencies and assigns to the Secretary of Commerce the responsibility to develop and recommend uniform Federal ADP standards and to undertake the necessary research in computer science and technology. Executive Order 11717 transfers the responsibility for developing Federal data standards from OMB to NBS and assigns to the Secretary of Commerce the authority to approve Federal ADP standards. ICST, through its Brooks Act mandate, is recognized as the *de facto* spokesman for the largest single ADP user in the nation, i.e., the Federal Government. In this capacity, ICST substantially accelerates a process which results in off-the-shelf ADP products and, therefore, in lower costs to large private and public sector ADP users. As a user representative (often the *only* user representation), ICST has staff members on about sixty voluntary standards committees and chairs about a dozen of them. To ensure that these responsibilities have a sound scientific base, NBS performs research in areas such as the development of computer network protocols, which permit the sharing of expensive information resources through the interconnection of computers with other computers, terminals and word processing devices; database management; and high level computer languages. Research done in ICST laboratories is necessary both to establish the scientific basis for technical guidance and also to ensure that ICST's "user voice" is, in fact, technically knowledgeable and that leadership in the voluntary arena provides guidance toward the optimum blend of user requirements and production feasibility. The laboratories provide a central testing facility where developing standards can be proved out. In the case of the ICST network protocol laboratory, over 80 vendors have expressed interest in participating in a cooperative testing program.

OMB Circulars A–108 entitled "Responsibilities for the Maintenance of Records About Individuals by Federal Agencies" and A–71 (TM–1) entitled "Security of Federal Automated Information Systems" assign to the Department of Commerce direct responsibility for issuing standards and guidelines on computer and data security. All Federal agencies are required to assure the certification and accreditation of computer security when sensitive data are involved. The concern with privacy and security is also shared by private industry. The results of these NBS efforts are used by such organizations as the American Institute of Certified Public Accountants, the Social Security Administration, Citibank, GSA, General Accounting Office (GAO), and the Electronic Data Processing Auditors Association.

Speaking with a technically knowledgeable user voice, ICST encourages the consensus that leads to standardization and subsequently to competition within an aggregated, and therefore expanded, market. Without ICST's vigorous participation, the voluntary standards process historically has tended to bog down, with the effect of limiting the aggregation of the market domestically and

fostering exclusionary practices internationally. The standardization efforts are equally important for the protection of the international competitive position of the American ADP industry—an industry that produces a favorable balance of trade in excess of $18 billion annually.

Recent accomplishments include the following:

Development of scientific basis for the formulation of guidelines to assist agencies and industry in detecting fraud and misuse of computer systems.

Issuance of technical information on domestic and international standards writing activities.

Issuance of technical information for local area network interface standard.

Issuance of transport and session protocol specifications which will provide for the reliable transmission of data between different computers on a network and will facilitate information and resource sharing.

Development of a guideline to assist agencies in detecting fraud and misuse of computer systems and to recommend proper controls.

Development of a guideline to help agencies select and evaluate commercially available software.

Issuance of an update of technology forecast with in-depth treatment of microprocessors.

Planned accomplishments for fiscal year 1985 include the following:

Issue information on the status of standards development in national and international voluntary standards activities.

Develop information on the use of local area networks.

Develop a virtual terminal protocol standard to permit terminals with different characteristics to be interconnected through networks.

Develop a file transfer protocol to provide a common representation and access method to files.

Provide technical advice to U.S. policy makers in the area of international ADP/telecommunications standardization.

ICST's reimbursable services complement the research performed under STRS funding. The unique expertise gained through the research program is applied to other agency problems, and the real-world experience is in turn transferred back to enrich the knowledge base of the research. Examples of cost-reimbursable work include software engineering for the Department of Defense (DOD) in support of the development of ADA language for command control applications; software engineering for NASA; system selection for the Federal Aviation Administration (FAA) to use in replacing their major air traffic control system; computer security for the Nuclear Regulatory Agency, the State Department, the FBI, DOD, and the Defense Communications Agency (DCA); large-scale system integration for Defense Nuclear Agency; high level systems protocols that will enable DCA to convert to the international standards being developed by ICST; and office systems and local area networks for the FAA.

4. CORE RESEARCH PROGRAM FOR INNOVATION AND PRODUCTIVITY (Sec. 201(a)(4))..... $12,168,000

The Bureau Core Research Program for Innovation and Productivity for fiscal year 1985 would include work in four areas: Very Large Scale Integrated Circuits (VLSI); Automated Manufacturing, Robotics, and Metals Processing.

This program of research is geared toward removing technological barriers that would otherwise significantly restrain the introduction of new products and processes. Projects are identified and undertaken on the basis of their potential utility for industry. The following criteria are applied in project selection: (1) Opportunities must already be recognized by industry; (2) advancement must depend on the removal of a scientific or technological barrier; (3) the solution must have potentially significant impact on the economy and on industrial productivity; and (4) the solution must require the Bureau's exceptional expertise in measurement and materials.

The goal of this activity is to develop measurement and standards-related services important for industries affected by emerging high technologies. This goal supports the DoC goals of providing technological information, products, and services to meet the major long-term needs of U.S. industry and promoting the development and application of science and technology in U.S. business and industry.

The objectives include:

Carry out fundamental materials science research related to the advanced industrial metals processing techniques of rapid solidification, alloy coating production and alloy phase diagrams.

Provide national reference standards, measurement methods and supporting data for the removal of market barriers for buyers and sellers of semiconductor production equipment, materials, and devices with emphasis on advanced technologies such as very large scale integrated (VLSI) circuits.

Provide the scientific and technical base and the technical assistance and leadership which will permit the private sector to adopt interface standards for elements of automated manufacturing systems for discrete parts.

Provide measurement methods and standards for the units of length, mass, and their derived quantities such as force and acceleration, which are required to support the national measurement system and, in particular, those that are required in automated, manned, or combined man-machine modes of mechanical manufacturing.

Operate an automated manufacturing research facility that will enable the investigation of the applicability of hierarchical controls systems or modularity concepts for robotic systems.

MEASUREMENTS AND STANDARDS FOR ADVANCED METALS PROCESSING... $700,000

This program is aimed at providing the measurement methods, standards, and data bases that will allow more rapid industrial adoption of innovative metals processing technologies which can reduce processing costs by as much as 10 to 15 percent in large segments of the metals industry. The segments of industry most affected will be the specialty alloys industries, especially steel and aluminum, and some of the major manufacturing sectors including

automobile, truck, and aircraft manufacturers, metallic coatings and plating industries, and aluminum and steel foundries. Finally, advances in these technologies will aid development of substitutes for scarce metals and reduce dependence upon unreliable foreign sources of alloy materials not found in the United States.

Specific activities focus on the measurement, modification, and control of the structure and properties of metals made by the advanced processing techniques of rapid solidification and alloy coating. Rapid solidification is the high speed transformation of metal from a liquid to a solid state and can be achieved by atomization, melt spinning, or directed high energy surface melting. Alloy coating is the formation of alloy surfaces on less expensive substrate materials thereby providing improved corrosion and wear resistance with greatly reduced use of critical elements. Alloy phase diagrams developed in this program provide graphic displays of the phases produced when two or more metals are combined. Phase diagram information allows prediction of the composition and properties of metal combinations under changing conditions and is instrumental in efficient selection, use, and processing of alloys, including design of new alloys and the development of novel rapid solidification and alloy coating processes. The new rapid solidification and coating processing methods are more efficient than existing technologies and are currently being developed by industry for specialized applications related primarily to defense and space needs.

Expertise and facilities developed in the advanced metals processing program have enabled NBS to determine for the Department of Defense and its industrial contractors conditions, quantitative data and guidelines fundamental to tailoring new compositions and process conditions for alloys with properties unobtainable by conventional means. For example, the Defense Advanced Research Project Agency needed phase diagrams evaluated in the NBS program for design of high strength, low weight aluminum alloys for use in aerospace applications; using unique NBS diffusion processing expertise, alloy coatings produced at unusually low temperatures were investigated for the Army Research Office as a basis for new chromium coatings on carbon steel to replace stainless steel in corrosion resistant military equipment.

Recent accomplishments include the following:

Production of high quality research samples of rapidly solidified aluminum alloy powders to support the development of innovative metal alloys with improved properties.

Determination of relationships between electrodeposition processing characteristics and the corrosion, wear, and mechanical properties of pulsed-electrodeposited alloy coatings that have improved reliability.

Completion of evaluation of 15 aluminum, iron, and titanium based binary phase diagrams which provide important data for alloy design and control of innovative metals processing techniques by industry.

Planned accomplishments in fiscal year 1985 include the following:

Develop acoustic techniques to rapidly determine the internal temperature distribution and the location of gross flaws in

hot steel ingots during processing. This is a collaborative effort with the American Iron and Steel Institute.

Determine microstructure, bulk structure and properties of rapidly solidified material using hot isostatically pressed powder.

Complete evaluation of 15 additional aluminum, iron, and titanium based binary diagrams. Complete review of 60 evaluated phase diagrams by ASM/NBS worldwide category editors, and publish in NBS-managed "Bulletin of Alloy Phase Diagrams." This is a collaborative effort with the American Society for Metals. This data forms the basis for the design of new rapidly solidified alloys.

SEMICONDUCTOR PROGRAM $5,447,000

This program provides measurement methods and physical standards that remove market barriers for buying and selling semiconductor production equipment, materials, and devices. Market barriers include those areas of technical disagreement between buyers and sellers associated with measurement of characteristics such as dimensions and electrical performance of integrated circuit elements. Activities include (1) providing the scientific and technological information necessary for development of voluntary or de facto standards; (2) advancing basic dimensional and materials measurement sciences necessary for setting and satisfying product specifications; and (3) developing measurement methods, physical standards, and supporting data. Areas of emphasis for this program are: electrical characterization of defects, insulators and interfaces, micrometrology, test structures, device metrology, and modeling of devices and device phenomena.

A major component of this program addresses new measurement science for Very Large Scale Integrated (VLSI) circuits. The greatly reduced dimensions (micrometer and submicrometer, i.e., approaching the size of less than a hundredth of a diameter of a human hair) and the vastly increased complexity of these circuits require tighter control of dimensions, materials purity, and other parameters, as well as new testing concepts. Responsive measurement science is needed to remove market barriers and reduce transaction costs between manufacturers and buyers of semiconductor materials and production equipment, and between manufacturers and buyers of the final integrated circuits, transistors, and other semiconductor devices. All industries employing these advanced devices are affected, including the automobile, computer, communications, aerospace, and defense industries. Program results also contribute to productivity improvements in manufacturing processes and to the efficiency of government operations that employ such devices. These efforts will assist U.S. industries in meeting foreign competition from such countries as Japan, West Germany, the United Kingdom, and France.

The capability developed in this program with appropriated funds has enabled NBS to respond to the needs of other government agencies and the private sector on a reimbursable basis. For example, this program has produced Standard Reference Materials (SRM's) that provide the bases for critical measurements made during the manufacture and sale of integrated circuits and fabrica-

tion equipment. Also, with DOE funding, this program developed standards for testing radiation hardness of integrated circuits used in military and civilian systems, including satellite and terrestrial communication systems and computers. NBS assistance has been sought by Government and industry because NBS' special metrological expertise and neutral posture assure the wide acceptance of findings necessary for marketplace decisions.

Recent accomplishments include the following:

Comparison of ellipsometric (optical) and electrical measurement methods for characterization of oxides and interfaces. This comparative assessment is an essential element in the assurance of process and product quality for metal-oxide-semiconductor (MOS) integrated circuits, the fastest growing segment of the integrated-circuit market.

Development of a scanning-electron microscope linewidth measurement system for dimensions as small as 0.1 micrometer. NBS will use this system for subsequent development of calibration methods for electron-beam systems used by industry to fabricate and measure VLSI circuits.

Evaluation of the potential of using a thermal test chip as a standard for determining the thermal properties of VLSI packages, which must dissipate unusually large amounts of heat and accommodate many connections. The findings are required by buyers and sellers for establishing and specifying package quality.

Planned accomplishments in fiscal year 1985 include the following:

Develop methods for measurement of integrated circuit linewidths with scanning-electron microscopes (SEM). Consistent SEM measurements are necessary to assure product quality in the manufacture of advanced integrated circuits.

Develop a physical standard and related measurement procedures to assure consistent calibration of systems that measure the widths of lines patterned in optical and e-beam resists. This standard will enable consistent measurement of linewidths (formed by multiple fabrication technologies) and thus aid in assuring product quality for complex VLSI circuits.

Document the approaches required to adapt NBS contact-resistance test structures to measurements for VLSI circuits. These test structures will further productivity and product quality assurance by providing a means for evaluating process performance.

Develop preferred methods for thermal characterization of VLSI circuits and packages. These methods are essential for the specification and evaluation of VLSI packages.

AUTOMATED MANUFACTURING INTERFACE STANDARDS $1,896,000

This program carries out scientific and technical activities that enable the private sector to adopt interface standards for elements of automated manufacturing systems for discrete parts. These activities include fundamental measurement and engineering science research in such areas as artificial intelligence, hierarchical control theory, control systems architectures, robot sensors, and software engineering. Full-scale, real-time experimental testing of the

theories and concepts developed in this program will also be conducted on the NBS Automated Manufacturing Research Facility (AMRF).

The discrete parts manufacturing industries produce things one at a time, such as aircraft components, auto parts, and machine tools. These industries are in a position to benefit from automation. They produce 75 percent of all U.S. manufactured goods in trade while contributing $150 billion in value added to the Gross National Product. This sector of the U.S. economy includes 35 percent of all U.S. firms, with over 100,000 of these (or 87 percent of the total) having less than 50 employees. Automation is critical for the U.S. manufacturers to compete in both foreign and domestic markets with Japan, Germany, and other industrial countries having major national programs in automation. Automation in these domestic industries is also critical to the Nation's ability to mobilize rapidly in time of national emergency.

The completely automated small-batch manufacturing system or flexible manufacturing system consists of a series of elements. The elements include metal cutting machines, computers, terminals, robots, conveyers, measuring or inspection systems, and a host of other mechanisms each with its own microprocessors. For the most part, each of these separate components are produced by different manufacturers. Therefore, the small-batch manufacturer who wishes to automate must buy various components from various manufacturers and is then faced with the problem of making the various components work together. Some of the larger and more technologically sophisticated companies can do this successfully. However, most small-batch manufacturers lack the required technical capability. This lack of ability to combine automation equipment from different manufacturers is a serious barrier to the adoption of automation by small-batch manufacturers. Each of the above elements and systems must communicate with one another to receive instructions, report progress on the assigned tasks, and report unplanned events which require remedial action. Each of the many links requires an interface between disparate devices and hence an interface and communication protocol. This program provides the technical basis, required primarily by the voluntary standards community, to design these interfaces, standards, and protocols in such a way as to protect the proprietary software and hardware interests of the component manufacturers.

Other program efforts include the NBS staff working as a knowledgeable, neutral expert with a consortia of private sector organizations, standards-writing bodies, and other Federal agencies. These interactions are required if standards are to be developed and made available in a timely manner. This timely development of standards facilitates the rapid automation of this country's discrete parts industries.

The research performed under this program has also allowed NBS to respond to the needs of other Government agencies and the private sector on a reimbursable basis. For example, in cooperation with the Navy Manufacturing Technology Office, this program developed prototype state tables for a cell control system, implemented databases required for cell-workstation interfaces, and demonstrated network interconnection of cell control system to worksta-

tion control, all designed for utilization in an automated manufacturing facility. NBS also provided technical consultation to the Army on robot demonstration, design of instrumented grippers, and software for instrumented gripper control to enable them to apply robot technology to military systems. The Navy and the Army requested NBS to carry out this work because of the unique Automated Manufacturing Research Facility at NBS that allows for exploration in advanced manufacturing techniques and for technology transfer.

Recent accomplishments include the following:

Development of the user interface language needed for a robot with vision for programming of sensory interactive tasks. This should permit any sensory system to be connected to any robot.

Completion and implementation of a software management program which assures that all software written during this project is fully transportable and readily available for industry adoption.

Completion of all intra-work station interfaces necessary for independent operation of the NBS Automated Manufacturing Research Facility work stations. This provides a complete work station having components from different manufacturers.

Completion of the development of the generic control processor with cell (two or more work stations) databases and cell command languages to permit initial experiments on cell operation. A cell is required for testing interface standard concepts and theories.

Planned accomplishments in fiscal year 1985 include the following:

Operate the AMRF with five work stations under central control for three preselected part families. This will complete the construction phase of the AMRF and enable NBS to begin the research phase.

Complete working draft of Initial Graphics Exchange Specification (IGES) III which will permit full communication between all major Computer Aided Design (CAD) systems including those implementing solid modeling. This makes IGES applicable to all commercially available CAD systems with the corresponding productivity gains.

Demonstrate that control interfaces are robot independent by programming manipulative task off-line and executing identical programs on two robots of different manufacturers. This action will be the first demonstration of true off-line programming capability, the lack of which has been identified as the principal barrier to large scale robot application.

MECHANICAL ENGINEERING METROLOGY $4,125,000

This program carries out scientific and technical activities that provide the measurement methods and standards for the units of length, mass, and derived quantities such as force and acceleration which are required, in particular, in automated, manned, or combined man-machine modes of manufacturing. These activities include fundamental research which advances the state-of-the-art of length and force metrology. This program has research activities in

many areas, e.g., (1) the use of electron microscopy to measure submicrometer dimensions to very high accuracy; (2) the investigation of the basic scientific principles of force measuring transducers; (3) the thermal modeling, dynamic analysis, and modeling to correct for machine errors in three dimensions; (4) the computer analysis of precise images for dimensional inspection; and (5) the investigation of the inverse scattering of optical or acoustical radiation as a means of measuring the dimensions and/or surface finish of machined parts. Another major activity is directed at the development of measurement science, standards, and procedures that will enable the fully automated manufacturing system to make a part whose dimensions are correct to the required accuracy. The metrology developed in this program for the complete automated manufacturing facility is called deterministic metrology. The NBS Automated Manufacturing Research Facility will be the test bed used for the development of deterministic metrology.

The automated manufacturing facility of the future will have the measurement function incorporated in the automated manufacturing process thus eliminating the need for manual or automated measurement of parts during or after production. This advancement shifts the measurement emphasis to the actual manufacturing process for determining that parts will be made to the correct dimensions or shape. In the traditional manual or semi-automatic production environment there exist well-recognized, quality control systems which provide buyer and seller assurance that the products have the correct dimensions. These systems are supported by current NBS calibration programs. The deterministic metrology program will develop new physical standards, procedures, and measurement services to enable small-batch manufacturers to calibrate the machining tools used for product manufacturing to national standards thereby avoiding very costly product inspection operations.

This program serves the entire national economy by advancing the basic measurement science required for the accurate measurement of all lengths and forces. The development of deterministic metrology will produce major benefits principally for the automated small-batch manufacturers in the discrete part manufacturing industries. This metrology will enable the manufacturers to make parts to the correct dimension or shape without having to make separate, expensive measurements.

The technical capability developed under this program has enabled NBS to respond to requests to provide specialized services to other Government agencies and the private sector on a reimbursement basis. For example, NBS developed a prototype light scattering instrument for use in the National Aeronautics and Space Administration's (NASA) National Transonic Facility. NBS also completed the design and development of critical pieces of instrumentation in support of a Large Optics Diamond Turning Machine for the Defense Advanced Research Projects Agency. This program also performs calibrations to tie the properties of its products to international standards of length, force and mass, and to national standards of physical qualities, such as shape, acoustical power and surface finish. NBS was requested to do this work because no pri-

vate source could offer measurements of such high accuracy or traceability to national standards.

Recent accomplishments include the following:

Completion of the installation of the NBS Automated Manufacturing Research Facility which extended the concepts of automation metrology developed for the process of milling to other operations such as the operation of a lathe. This development provides traceability to the national standards of length without having to have a separate and costly post-production inspection operation.

Test of full adaptive control using deterministic metrology for high accuracy contour milling, thereby proving that this measurement concept can be implemented on the most difficult machining process.

Issuance of surface roughness artifacts covering the range of roughness with vertical dimensions down to 20 nanometers and in various lateral dimensions completing the new set of industrially important roughness standards. This is a measurement service which has been repeatedly requested for use in such areas as determining the surface quality of laser mirrors, the friction of moving parts, and the appearance of paint on surfaces.

Validation of an on-line roughness measuring system which proved feasibility of new metrology for an important characteristic.

Completion of feasibility experiments on the use of pulsed light as a convenient and fast technique for dimensional measurements. This technique can be used to measure the dimensions of medium size objects, e.g., 5 to 50 centimeters, in a very small fraction of a second.

Planned accomplishments in fiscal year 1985 include the following:

Complete development of a system to automatically generate inspection procedures from design data including demonstration of automatic program generation for inspecting edges and vertices and hence reduce software costs of automation.

Complete initial studies of the use of acoustic emission to monitor chip formation of machine tools as a more powerful sensor of tool condition to permit more effective tool life determination and reduce machining costs.

Complete exploratory investigations of the use of transient electromagnetic scattering for determination of dimensions and physical features of machined parts opening a completely new noncontacting and rapid measurement methodology.

Make operations of a robot vision system in an industrial environment capable of distinguishing shades of grey as opposed to current black/white systems providing for the first time capability in inspecting internal part details.

Publish a study quantifying thermal distortion errors in coordinate measuring machines to permit construction of machines of less expensive materials.

AUTOMATED MANUFACTURING RESEARCH FACILITY..... NONE

This program has last year provided the various machine tools, robots, controls, etc., necessary for the development of the AMRF required by the two associated programs, Automated Manufacturing Interface Standards and Mechanical Engineering Metrology. While the AMRF will resemble a flexible manufacturing system, the facility is not designed to be a production facility. Instead it is designed to present a variety of interfacing problems relevant to flexible manufacturing systems. The AMRF will include a number of robotic systems; in fact, the facility as a whole can be considered as a very sophisticated robot. Consequently, the facility will enable the investigation of the applicability of hierarchical control systems or modularity concepts for flexible manufacturing systems or robotic systems. In addition, it will allow the associated programs to address interface and metrology problems relative to robots.

In fiscal year 1984 NBS finished the procurement of components, e.g., a material handling system, controls, and robots necessary to complete the assembly of the Automated Manufacturing Research Facility.

ROBOTICS RESEARCH AND DEVELOPMENT..... $1,515,000

Robotics is the term commonly used for programmable automation. In this sense, robotics is the core technology of the NBS Automated Manufacturing Research program.

Robotics is a field of technology which is of growing importance to the productivity advancement of manufacturing technology in the U.S. It is also a field where some foreign countries, such as Japan, are technologically ahead of the U.S., and where foreign competition therefore is strong. Advances in the state of the art within U.S. industry can be materially aided by NBS's development of generally applicable techniques, concepts and standards.

Before automation technology can make further contributions to productivity improvement, it must be much more widely used throughout industry, and its ability to perform a much wider range of tasks must be improved significantly. The great majority of industrial tasks are currently beyond the capacities of present-day robot technology. Most industrial tasks now performed by humans are too complex or unstructured, or involve too many uncertainties, or require too much ability to see and feel and adapt to changing circumstances to be performed by machines. Although robots now are increasingly used in such operations as spray painting and arc welding, where the positioning of the tools is relatively simple, they are not yet able to perform such tasks as parts assembly. If robots are to perform such more complex tasks, they must be able to execute complex tasks with much greater dexterity, speed and flexibility than they are capable of now.

The Bureau is currently engaged in research on technologies which are focused on performance measures, programming language standards, better visual and tactile sensors, and hierarchical control strategies. The program in fiscal year 1985 will continue this research.

The objectives of this program during fiscal year 1985 will be:

Continue research and development on sensors needed for robots to see, feel, and determine position of objects.

Improve robot positioning ability in order to permit robots to pick up and deposit an object at a mathematically defined point in space with greater accuracy.

Continue research on control algorithms needed to permit robots to have increased flexibility.

Continue research on robot mobility, including the establishment of the requirements and the mechanical, sensor and logic feasibility.

Continue the development of control systems capable of dealing with a wider range of conditions and circumstances permitting wider application.

5. TECHNICAL COMPETENCE FUND (Sec. 201(a)(5))..... $8,598,000

This program was established to ensure NBS' technical expertise and to maintain the capacity to contribute effectively to future national needs and goals. The ability of NBS to respond to directly mandated responsibilities and needs of other Federal agencies arises from the basic technical competence of the NBS staff and a carefully planned program of long-term research. The most important impact of the competence building effort is technology and information transfer from the competence areas to the problem-solving areas of NBS and the user community.

The selection of specific competence projects is based on the following criteria: potential for long-range public and economic benefit; scientific and technical merit; match to NBS mission objectives; and potential for transferring outputs to NBS program areas and clientele. After identifying the scientific and technical areas where competence building efforts are needed, the critical size of these efforts and the desirable rate of development are determined and used to estimate the required resources in personnel, equipment, and operating funds. Priorities are determined considering the needs established in the initial assessment process, the impact on industry and society, scientific opportunity, and other factors. Resources are then allocated to competence efforts in order of priority. Adjustments of funding for specific projects are made depending on changing needs, rate of progress, and technical opportunities.

Some examples of the projects funded to date in the competence program include research in surface science, picosecond laser chemistry, ionizing radiation effects, quantum radiometry, compositional mapping, wave optics for metrology, compound semiconductors, gigabit electronics, and protein stabilization.

Recent accomplishments include the following:

Development of techniques to determine morphology, chemical and isotopic composition, and crystal structure of individual, submicrometer-sized particles. Such information is useful in understanding the behavior of small particles in physical, and technological processes.

Determination of the vibrational spectra of hydrogen-containing molecules on high-area catalyst materials by the novel method of neutron inelastic scattering. This will allow identification of the reaction pathways of prototype catalytic reactions.

Analysis and calibration of the degree of separation of charged proteins in a polyacrylamide gel matrix. This is a necessary prerequisite to achieving an accurate separation, identification, and quantitation system for complex biomolecules.

Development of a capability for fabricating Josephson "edge" junctions. These very small junctions are required to identify the limits of speed of digital measuring and signal processing circuits based on Josephson-junction technology.

Formulation and provision of model for transient heat transfer between binary fluid mixtures and solid bodies in transient thermal processes of emerging industrial importance. This will provide a foundation for optimization of new class of industrial heat transfer processes.

Planned accomplishments in fiscal year 1985 include the following:

Develop techniques to measure radiation damage in DNA bases and proteins and to identify the intermediate states and reaction rates that play key roles in cross linking processes. This information is needed to understand the nature of radiation damage, the modifying factors, and the coupling between radiation chemistry and the resulting biological effects.

Develop techniques to produce two dimensional maps of chemical composition with spatial resolution of less than 10 micrometers. This is needed to relate fundamental parameters and characteristics of materials to the microchemical composition.

Complete the first real-time measurement of microscopic densification processes in structural ceramics at high temperatures by small angle neutron scattering.

Develop a computer simulation program to examine the effects of species, molecular size, mass and polarity on thermodynamic and transport properties of diverse fluid mixtures to enable future development of wide-ranging equations and models to predict these properties in fluids of industrial importance.

Develop laser scattering and extinction measurement techniques to monitor growth and burnout of soot particles in flames to facilitate optimum control and efficiency of combustion in chemical reactors and furnaces.

6. FIRE RESEARCH CENTER (Sec. 201(a)(6))..... $5,827,000

This program carries out technical activities that provide the scientific and technical basis to reduce the Nation's fire losses and the cost of fire protection. The loss of life and property in the United States caused by fire is the worst of any major western industrial nation. The general strategy of this program is to develop in the laboratory the technical basis for fire hazard assessment for dissemination to the field. Some specific activities are: (1) laboratory and theoretical work on ignition, fire spread, smoke and toxic gas evolution and fire suppression and extinguishment; development of physical and chemical models for smoldering fires, and techniques for identifying gaseous species in flames; (2) research on such areas as the fire properties of materials, the relationship between fuel characteristics and flame spread, and the correlation between fire

behavior in small scale and full scale fires; and, (3) the development of predictive mathematical models of the evolution of fire hazards.

The development of a better understanding of basic fire phenomena and the development of advanced methods in the NBS laboratories for applying this knowledge contribute directly to improving the capacity to reduce fire losses, the cost of fire protection, and avoidance of new fire problems associated with modern designs and materials. For example, at present, the only way to determine the fire performance of a product or a building under a given set of conditions is to burn the product or building under each condition and record the results. This is impractical, costly, and hinders the development of fire resistant materials, cost efficient fire protection systems, and more effective codes and standards. The development of predictive mathematical models provides a solution to this problem.

Substantial benefits have been achieved by this program. For example, the new NBS Fire Safety Evaluation System for hospitals will save the U.S. public billions of dollars without reducing the fire safety of the building occupants. The System allows building designers to choose the most cost-effective options for meeting fire codes. Rehabiliation of a section of a single public hospital using the NBS system is credited with saving $4 million of an $11 million project. Another benefit of the NBS fire research program is the introduction and widespread use of smoke detectors, fire resistant mattresses and furnishings which have helped reduce the U.S. fire death rate over 20 percent within the last decade.

As a key part of the program, NBS provides $2.0 million annually in support of fundamental fire research to about 30 universities and other organizations. These grants are the only funding source for extramural research that supports the overall program and through which our Nation's new fire scientists are trained.

The NBS Fire Research Center is one of three closely coordinated federal efforts created by the Federal Fire Prevention and Control Act of 1974 (P.L. 93-498). The NBS provides the broad range of basic research needed to reduce this Nation's fire losses. The other two efforts are the United States Fire Administration and the National Fire Academy in the Federal Emergency Management Agency. NBS fire research is also coordinated closely with private sector organizations such as the National Fire Protection Association and others in the fire protection community.

The capability developed under this program has enabled NBS to respond to special requests from other Government agencies and the private sector on a reimbursable basis. For instance, for the Federal Aviation Administration, NBS conducted ignition and flame spread studies on aircraft materials. This study, along with other information including an NBS-developed decision model for aircraft fire safety, will be used to make more cost-effective fire safety decisions on the use of materials in aircraft. For the Nuclear Regulatory Commission, NBS conducted an evaluation of risk analysis procedures for nuclear power plants which will be used to assure fire safe operation of those plants. As requested by the Consumer Product Safety Commission, NBS completed tests on fires in chimneys, the results of which provide the technical basis for

changes in standards to reduce residential fires caused by heating appliances. These and other agencies came to NBS because of the unique capabilities of the NBS Center for Fire Research.

Recent accomplishments include the following:

Development of a test method for measuring flame spread over horizontal surfaces. Data on flame propagation over floors or furnishings are essential for modeling hazard development.

Construction of a preliminary framework, utilizing fire and smoke models, for evaluating the fire safety of specific buildings. This will provide fire protection engineers with recent computational advances to evaluate complex fire safety questions.

Development of an empirical correlation for the effects of fire size on water spray penetration of a hot flame plume. Residential sprinkler effectiveness depends on how much water reaches the burning fuel.

Validation of a model for smoke flow from the initial fire room into corridors and other rooms. The quantity and rate of smoke flow out of the initial fire room is a key factor in determining escape time and routes.

Planned accomplishments in fiscal year 1985 include the following:

Develop a preliminary predictive model for free-burning upholstered furniture. Such models and data are essential for assessing fire hazard.

Construct a physical explanation of the transition from smoldering to flaming combustion. Over one-fourth of all fire deaths result from fires that begin as smoldering.

Devise a method for predicting upward flame spread over materials. The rate at which flames spread on walls and other vertical surfaces is a prime factor in determining the time a room fire becomes untenable.

Develop means to predict activation time of thermal responding devices. The timing of initiation of automatic fire control suppression systems is critical to life safety.

Develop means to predict the evolution of the toxic hazard from a specified fire to occupants in a multi-story building. This model will be used to evaluate the relative contribution of smoke toxicity to the overall hazards of fire.

7. CENTRAL TECHNICAL SUPPORT (Sec. 201 (a)(7)) $15,065,000

The purpose of this subactivity is to provide NBS with technical support in the following areas: (1) *Research Associate Program*—provide outstanding scientists and engineers from industry, academia, and other Federal agencies an opportunity to participate in research programs in the various branches of physical, engineering and mathematical sciences; (2) *Computing Support*—provide computer support to NBS programs that is responsive to evolving scientific and engineering demands of NBS scientists, engineers and administrators to achieve the major mission goals of NBS; (3) *Facilities Modifications and Improvements*—maintain a satisfactory environment for conducting the NBS technical programs; (4) *Transfers to the Working Capital Fund*—ensure that sufficient funds are available for investment in depreciable equipment and inventories

of materials offered for sale; (5) *Non-Technical Support Services*—provide non-technical reimbursable support, principally for other Commerce agencies at the Boulder, Colorado, and Gaithersburg, Maryland, site; and (6) *Working Capital Fund (WCF) Investments and Operating Adjustments*—reflect changes and the level of WCF investments and operations, particularly investments in depreciable equipment and inventories of standard reference materials.

RESEARCH ASSOCIATE PROGRAM $2,652,000

This program consists of the Industrial Research Associate program, the Postdoctoral Research Associate program, and the Graduate Cooperative Education program. These components have the direct effect of maintaining NBS competence by making available each year more than 150 high caliber scientists and engineers for ongoing research programs and providing a mechanism for technology transfer of NBS research and methods to the scientific and engineering communities. The Research Associate program serves as an excellent information exchange system and recruitment vehicle.

The Industrial Research Associate program enables scientists and engineers from industrial, professional, trade, and other oganizations to work at NBS under the sponsorship of their employers who cover all personal expenses. These research associates contribute their special expertise, working with NBS staff on projects of clear mutual interest. In addition to providing an effective means of information exchange, this program also makes available to the private sector the excellent, and often unique, research facilities which exist in Government laboratories. Participants in the Postdoctoral Research Associate program are scientists and engineers who have recently earned their doctorate degree and have demonstrated superior ability for creative research. The prospective candidates are evaluated by the National Academy of Sciences/National Research Council. Associateships are awarded for work at NBS in the various branches of the physical, engineering, and mathematical sciences. Their significant contributions to ongoing research programs at the Bureau often result in their becoming permanent employees of NBS. Through the Graduate Cooperative Education program, students are appointed to work at NBS to enhance ongoing research programs. Many of these students are hired by NBS upon completion of their graduate work. Both the Postdoctoral Research Associate and Graduate Cooperative Education programs are fully supported by appropriated funds.

Recent accomplishments by the group of postdoctoral associates include the following:

Determination of thermochemical effects on microstructure and dielectric properties of zirconium titanate based ceramics, necessary for the design of advanced microwave devices.

Evaluation of the feasibility of prototype primary frequency standards based on laser cooled beryllium ions.

Development of isotope dilution mass spectrometry as a definitive analytical technique for important organic constituents including cholesterol, glucose, uric acid, urea, and creatinine in human body fluids. This technique serves as the accuracy base for national and international testing of reference methods and Standard Reference Material certification.

Development of advanced techniques of Lie groups and algebraic manipulation needed for precision spectroscopy, ultra-high-speed electronic circuits, and orbit calculations for time-signal satellites.

COMPUTING SUPPORT $8,079,000

This program provides central computing facilities for all NBS programs. Acquisition of a replacement scientific computing system was begun in fiscal year 1982. Following a General Accounting Office study requested by the House Government Operations Committee the Deputy Secretary of Commerce called for a study of NBS and National Oceanic and Atmospheric Administration (NOAA) central computing requirements. This study was completed in January 1983 and the decision was made by DoC to provide a consolidated system for NBS and NOAA. NBS has, only as an interim measure, installed a limited capability upgrade of its obsolete central computing system which will improve computing capabilities at NBS until the new replacement system becomes operational. In fiscal year 1984, this program will continue to acquire external computing capability to provide computing services to all scientific programs at NBS.

In its fiscal year 1985 budget request, NBS proposed a one-time increase of $8,874,000 to procure and install a Class VI consolidated computing system to provide supercomputing capability for NBS and NOAA/ERL. This computing capability will enhance the scope and effectiveness of NBS's use of modern supercomputers in the long range solution of important problems in such areas as atomic and molecular properties, radiation transport, electronic materials, chemical processing, biotechnology, computer aided design/computer aided manufacture (CAD/CAM), robotics and automation and ERL's research into problems in the areas of aeronomy, wave propagation, severe storms, and marine environment.

Because of the severe budgetary constraints in effect this fiscal year, H.R. 5172 will provide only $4.3 million for the Class VI computing system. NBS's request of $8.9 million was based on an overly optimistic schedule of procurement, installation, testing, and final payment in fiscal year 1985.

NBS and NOAA/ERL funds in hand, plus the fiscal year 1985 authorization of $4.3 million, should adequately cover Class VI computing needs in fiscal year 1985.

FACILITIES MODIFICATIONS AND IMPROVEMENTS $669,000

The program to systematically replace aging and obsolete facilities and equipment is continuing. As the National Bureau of Standards facilities become older (the Gaithersburg facility is 18 years old and the Boulder facility is 28 years old) the need for improvements, modifications, and repair or replacement becomes more important. On more and more occasions, extraordinary repairs are necessary to restore service after equipment failures. For example, recently deteriorated insulation in a high voltage switch gear resulted in an interruption in electrical service for approximately one and a half days in one of the general purpose laboratories (GPL's). The potential consequences of system or equipment failure at either of the Bureau sites go beyond the apparent loss of em-

ployees time and inconvenience. Costly long-term research could be seriously damaged or destroyed. Sensitive technical equipment could be damaged beyond repair. It is, therefore, especially important that preventive maintenance be accomplished at a level to avoid such failures.

Recent accomplishments include the following:

Maintain the plant facilities and equipment at a level responsive to NBS programs.

Continue replacing facilities and equipment in order to avoid excessive maintenance costs. Examples include: Replacement of 55° chilled water systems in two GPL's; Selected replacement and repair of roads and parking lots; Repair roofs of two GPL's and one special purpose laboratory; and Replacement of corroded fume hood, fan, and duct systems.

Implement cost-effective energy conservation measures to meet regulatory and legislative requirements.

Planned accomplishments in fiscal year 1985 include the following:

Maintain the plant facilities and equipment at a level responsive to NBS programs.

Continue replacing facilities and equipment in order to avoid excessive maintenance costs. Plans include: Replacement of deteriorated chilled water cooling system for laboratory equipment, Major roof replacements; Road and parking lot repairs and sealing; and Central chilled water system energy conservation improvements.

TRANSFERS TO THE WORKING CAPITAL FUND $3,665,000

The funding level of $3,665,000 in fiscal year 1985 will permit NBS to (1) finance $3,265,000 to recover the replacement value of the NBS depreciable equipment inventory that has been eroded by inflation, and (2) provide $400,000 for capitalization of Standard Reference Materials (SRM) research and development costs.

Planned accomplishments in fiscal year 1984 and 1985 include providing a permanent capital base for investment in depreciable equipment.

NONTECHNICAL SUPPORT SERVICES ..... NONE

This program supports miscellaneous, non-technical services principally to other Department of Commerce agencies on a reimbursable basis at both the Boulder, Colorado, and Gaithersburg, Maryland, sites. Examples of these services include telephone services, plant services and space rental.

WORKING CAPITAL FUND (WCF) INVESTMENT AND OPERATING ADJUSTMENTS ..... NONE

This program reflects changes in the level of WCF investments in depreciable equipment and investments of Standard Reference Materials (SRM's) and general storeroom supplies. In addition, adjustments in the WCF activities operated on a profit and loss basis are also included in the program.

Office of Productivity, Technology and Innovation

(Sec. 203 (a)) $4,121,000

The goal of the Office of Productivity, Technology and Innovation is to stimulate U.S. private sector productivity, international competitiveness, and economic growth by: identifying, analyzing, and seeking the removal of barriers to productivity by developing new policies or other appropriate actions; facilitating private joint research arrangements to achieve major advances in technology; disseminating productivity know-how to business; coordinating Federal patent policy to increase the commercialization of innovations; and promoting voluntary private sector conversion to the metric system.

PRODUCTIVITY ENHANCEMENT..... $1,059,000

The objective of this program is to identify and analyze factors impeding productivity growth, to develop long-term policy options for mitigating or eliminating them, and to recommend actions producing an economic climate conducive to productivity enhancement. Policy recommendations are produced to encourage public or private mechanisms for enhancing productivity, and for rendering information and technical assistance to business and state and local government.

Examples of specific work include the following:

Examining the relative contributions to productivity growth (or decline) of such factors as capital, energy, Government regulation, human resources, measurement, etc., and recommending appropriate actions to produce positive results for each;

Providing basic information, analyses, or option papers on request to policy-level officials, cabinet committees (Cabinet Council on Economic Affairs, Cabinet Council on Commerce and Trade), or special organizations (e.g. President's Commission on Industrial Competitiveness);

Maintaining contact with and providing representations to domestic and international productivity organizations (e.g. the American Productivity Center, the European Association of National Productivity Centers) and to ensure ready access to the latest state-of-the-art knowledge, for integration into policy papers or for responses to information requests.

Operating a measurement program designed to promote the use of firm-level productivity measurement, to contribute to the improvement of Federal productivity data/statistical analysis, and to seek the utilization of multi-factor productivity measures at all levels of the public and private sector.

Administering a Productivity Steering Group as the principal mechanism for coordinating DOC strategic planning, productivity information exchange, data collection, research, and contact with the Cabinet Council on Economic Affairs, the President's Commission on Industrial Competitiveness (PCIC), the Congress and the private sector.

Information and outreach—Through the Commerce Productivity Center, a national clearinghouse, information on productivity improvement methods is collected and disseminated upon request to provide U.S. firms and business organizations with tested practical tools for enhancing productivity. GAO, private sector productivity centers, and industry have identified this function as an essential Government responsibility (i.e., one which does not compete with

private information activities) needed especially by small- and medium-sized firms.

A small business initiative was begun to enhance the ability of smaller firms to commercialize technology and successfully enter emerging competitive markets.

In the fields of research and information—OPTI handles the numerous requirements contained in Section 5c of the Stevenson/Wydler Technology Innovation Act for studies, assessments, policy experiments, etc. involving the relationship of technology and the U.S. economy (e.g., employment, trade, and capital formation).

COORDINATION OF FEDERAL TECHNOLOGY MANAGEMENT POLICY $507,000

This program coordinates and monitors Federal technology, management, transfer, and patent policy including promotion of private sector opportunities for commercializing inventions resulting from projects financed with Federal Government funds. The Patent and Trademark Amendments Act of 1980 (P.L. 96–517) included provisions to give small business, and non-profit organizations, and universities first right of refusal to title to inventions made with Government funding. To the degree allowed by statute, the right of contractor ownership was extended to nearly all Federally funded R&D performers by a Presidential Memorandum on February 18, 1983. In addition, Government agencies are encouraged to grant exclusive licenses for Government-owned inventions.

A primary purpose of the Stevenson-Wydler Technology Innovation Act (Public Law 96–480) is to encourage transfer of technology from the government to industry. It includes a number of actions required of the agency. The Act requires that commerce help agencies implement the Act, to analyze and report on activities under the Act, and to recommend legislative changes. This program provides a centralized focus for oversight and evaluation of the implementation of both patents and technology management policies, and the response of the private sector to both sets of policies.

This program performs the following functions:

Assists the Executive Office of the President and affected Federal agencies in developing the statutory and administrative procedures necessary to establish and monitor a uniform patent policy, and undertake the management, oversight, and evaluation of this policy to assure its effectiveness.

Develops systems for use by all Federal agencies to identify inventions with significant commercial potential, increase the commercialization of these inventions, reduce the costs of protecting the Government's interest and provide incentives for Federal employee inventions.

Coordinates the establishment of uniform invention report forms, utilization report forms, critiera for filing patent applications on Government-owned inventions, and standards for disposition of Government-employee inventions. In the absence of uniform Government-wide standards, agency management of patents has been uneven. Sound criteria for filing patent applications on Government-owned inventions and a uniform invention report form will reduce public paperwork and regulatory burdens.

Evaluates the effectiveness of the Patent and Trademark Amendments Act and Executive Office procedures and, in coordination with other agencies, makes recommendations for legislative or regulatory changes, as appropriate.

Convenes conferences and workshops to assist Federal agencies, businesses, and universities to implement the new Federal patent and technology management policy. Such workshops would have as a primary objective the provision of information on how to get access to patent rights on Federally-funded inventions and on Federal policies regarding the commercialization of those inventions.

Chairs a Federal agency committee to provide information and guidance to assist the Department in performing its Federal patent and technical data policy functions.

Coordinates administration positions on proposed legislation related to technology management and ownership of inventions made with Government support. This function would be supported by the Department's data base on agency implementation of Federal patent policy and its chairmanship of the committee cited above.

Monitors the Federal patent policy and procedures of other key trading partners and the rights of U.S. companies in acquiring patents owned by foreign governments.

Monitors related technology management and transfer functions of Federal agencies as such agencies seek to diffuse their technology to U.S. industry by means other than through patent rights including participation in Industrial Technology Limited Partnerships and Federal laboratory/industry collaboration.

CONVERSION TO THE METRIC SYSTEM $370,000

This program administers those Federal functions and responsibilities related to producing an environment favorable to the voluntary conversion to the metric system in the United States. This Office has been in existence since October, 1982, at which time the Department of Commerce was given the responsibility for removing the barriers to voluntary conversion. A Plan of Action for meeting this goal has been developed.

One of the main mission of the Department of Commerce is to promote U.S. exports to expand our share of the international marketplace and improve our trade balance. To compete effectively in foreign markets, the U.S. must consider producing metric products. The U.S. is one of only three countries (Brunei, Burma, and South Yemen are the other) which have not announced plans to convert to predominant or exclusive use of the metric system.

This Office performs those activities which are crucial to providing the private sector with a clear message that use of the metric system is to be encouraged and to lay the groundwork for the time when the U.S. will be predominately metric. The Office works with industrial and business organizations, other Federal agencies, and state and local governments to develop a cooperative program that will facilitate planning for metric conversion. Much of the interaction with the provate sector is coordinated through the American National Metric Council. At the request of the Council, the Depart-

ment of Commerce cosponsored their 9th and 10th Annual Conferences.

The Office provides information regarding metric laws and practices in international trade both directly and with the assistance of offices of the International Trade Administration.

Coordinating the Federal government's own metric conversion activities is an important continuing role of this Office. A new charter for the Interagency Committee on Metric Policy was issued by the Secretary of Commerce on March 28, 1983. The experience of the Defense Department has shown that the absence of metric procurement standards is a barrier to conversion within the DoD necessary for interoperability of equipment within NATO and with other allies. Therefore, the Defense Department has established a target date of 1990 by which all of its standards and specifications that are measurement sensitive be also available in metric designations. The Office has worked with the General Services Administration and with many private sector standards organizations in issuing the Federal regulation dated January 23, 1984, on the use of metric units in Federal standardization documents. The Office will work with the private sector in supporting the development and operation of a log of metric standards. The Office also publishes the Federal Metric Status Report and the Federal Metric Information Referral Directory.

The Office also uses the National Council on State Metrication and the National Conference on Weights and Measures as two-way information exchange mechanisms among States and with the Federal government.

The Office is responsive to requests for interviews and information from the news media and for information from the general public. Approximately 250 general information inquiries are received each week with an additional 25 requesting specific, often complex, information. Publication of articles for the trade press on metric conversion is carried on and numerous talks to industrial and technial associations are presented. The presence of single Federal focus for metric activities is important to assure that the transition to the metric system occurs as efficiently as possible in a coordinated and coherent manner.

PATENT LICENSING PROGRAM $910,000

This program seeks to improve productivity and encourage innovation in the domestic economy through the licensing of U.S. Government invention technology. It also seeks to bring selected inventions to the attention of U.S. industry through direct industry contacts and specialized marketing strategies, prevent unrestricted, uncompensated foreign use of U.S. Government invention technology, and protect important foreign markets for U.S. trade and development by the filing of foreign patent applications on selected inventions. This program provides the mechanism for greater utilization of the many inventions to which the Government has title and are available for licensing.

INDUSTRIAL TECHNOLOGY PARTNERSHIPS $525,000

OPTI works with the private sector, universities, research institutes, and state and local governments to encourage the formation

of joint R&D ventures of various types. This includes the formation of research and development limited partnerships (RDLP's) and more traditional cooperative R&D ventures, as well as ways of linking these mechanisms as a means of creating base technology and commercializing new products and processes.

These ventures, which benefit from tax incentives, can contribute to strengthening the technological competitiveness of U.S. industry vis-a-vis foreign targeted industry strategies. RDLP's can increase the pool of capital available for R&D, finance the commercialization of federally owned or developed technology, shorten the development time of new technologies, and help integrate institutions and disciplines into a coherent technology development program.

OPTI's program in this area (the Industrial Technology Partnership Program) clarifies the application of tax and antitrust laws through the development and dissemination of guidelines, seeks changes to these laws where necessary to facilitate the formation of RDLP's and cooperative R&D projects, and familiarizes potential general partners with the RDLP concept, Administration policy, and the availability of related government programs (such as patent licensing and the Center for the Utilization of Federal Technology). In addition, OPTI operates a research associates program by which business persons and others can spend up to a week with OPTI; convenes workshops or meetings on behalf of a potential general partner or members of a cooperative venture; works with universities or local governments in an effort to help them identify potential roles in RDLP's (which can also serve to augment the transfer and commercialization of Federally-funded technology); and develops data bases for RDLP-candidate projects identified by the private sector. Further, there is an extensive outreach effort to inform the business and research community of the advantages of RDLP's. Additional activities for fiscal year 1985 include networking/referral services for small business such as invention evaluation, government programs, and sources of engineering services.

JAPANESE SCIENCE AND ENGINEERING LITERATURE $750,000

Of the $4,121,000, which H.R. 5172 would authorize to be appropriated to the Assistant Secretary of Commerce for Productivity, Technology and Innovation, $750,000 would be available, in whole or in part, through the National Technical Information Service (NTIS) to make the science and engineering literature of Japan more accessible to United States scientists and engineers. The National Technical Information Service has the responsibility of actively collecting, translating, and disseminating technical information of potential interest to U.S. industry. Recognition of the fact that Japan is making valuable contributions to science and technology, and that the United States appears not to have the adequate resources to take advantage fully of acquiring this information led to Committee support for Federal funding for this program.

OFFICE OF THE SECRETARY OF COMMERCE

METRIC STUDY (SECTION 204) $500,000

H.R. 5172 would authorize $500,000 to the Office of the Secretary of Commerce to conduct an independent study of all factors relating to conversion to the Metric system of measurement in the United States. This study is intended to provide Congress and the Executive Branch with the necessary information on which to base Federal policy decisions regarding the metric conversion.

The need for this comprehensive survey of the current status of metric conversion efforts in the U.S. arises from the lack of clear governmental policy to guide U.S. industry in this important area. In 1975, Congress passed and the President signed Public Law 94-168 (the Metric Conversion Act of 1975), which declared that "the policy of the United States shall be to coordinate and plan the increasing use of the Metric system in the United States." However, subsequent actions by this Administration, such as the phasing out in 1982 of the U.S. Metric Board, have raised industry's doubts about the seriousness of U.S. commitment to metric conversion. A clarification of U.S. policy, based on the latest available data, is therefore in order.

The study authorized by H.R. 5172 would pay particular attention to the impact of metric conversion on the international competiveness of U.S. firms which have a strong reliance on foreign sales. The study would also include a cost/benefit analysis of the cost to U.S. business of not converting to the Metric system; an analysis of the benefits and problems which conversion would have upon small business; and other topics pertinent to the subject area.

6. SECTIONAL ANALYSIS OF THE BILL

H.R. 5172

A bill to authorize appropriations to the Secretary of Commerce for the programs of the National Bureau of Standards for fiscal years 1984 and 1985, and for other purposes. This Act may be cited as the "National Bureau of Standards' Authorization Act for Fiscal Years 1984 and 1985".

TITLE I. AUTHORIZATION FOR PROGRAM ACTIVITIES, FISCAL YEAR 1984

SECTION 101

This section authorizes appropriations to the National Bureau of Standards for fiscal year 1984 in the amount of $115.7 million. The budget activities are authorized as follows:

(1) Measurement Research and Standards, $50,166,000.
(2) Engineering Measurements and Standards, $21,276,000.
(3) Computer Science and Technology, $10,000,000.
(4) Core Research Program for Innovation and Productivity, $12,053,000.
(5) Technical Competence Fund, $8,169,000.
(6) Fire Research Center, $5,827,000.
(7) Central Technical Support, $8,227,000.

This section also provides that, of the funds authorized for Engineering Measurements and Standards, not less than $4,000,000 shall be available for the Center for Building Research.

This section also provides that, of the funds authorized for Measurement Research and Standards and Engineering Measurements and Standards, not less than $1,000,000 shall be available for Measurement Standards for the Handicapped.

This section also provides that, of the funds authorized for Computer Science and Technology, not less than $10,000,000 shall be available for Computer Science and Technology.

This section also provides that, of the funds authorized for the Core Research Program for Innovation and Productivity, not less than $3,500,000 shall be available for Robotics Research and Development.

This section also provides that, of the funds authorized for the Fire Research Center, not less than $5,827,000 shall be available for the Fire Research Center.

This section also provides that, of the funds authorized for Central Technical Support, not less than $400,000 shall be available for the Central Planning Office.

SECTION 102

This section authorizes $700,000 in excess foreign currencies for expenses of the Bureau incurred outside the United States.

SECTION 103

This section authorizes $3,625,000 in funds to be appropriated for activities in the field of innovation and productivity by the Office of Productivity, Technology and Innovation.

TITLE II. AUTHORIZATION FOR PROGRAM ACTIVITIES, FISCAL YEAR 1985

SECTION 201

This section authorizes appropriations to the National Bureau of Standards for fiscal year 1985 in the amount of $132.8 million. The budget activities are authorized as follows:

(1) Measurement Research and Standards, $57,948,000.
(2) Engineering Measurements and Standards, $23,194,000.
(3) Computer Science and Technology, $10,000,000.
(4) Core Research Program for Innovation and Productivity. $12,168,000.
(5) Technical Competence Fund, $8,598,000.
(6) Fire Research Center, $5,827,000.
(7) Central Technical Support, $15,065,000.

This section also provides that, of the funds authorized for Engineering Measurements and Standards, not less than $3,969,000 shall be available for the Center for Building Research.

This section also provides that, of the funds authorized for Computer Science and Technology, not less than $10,000,000 shall be available for Computer Science and Technology.

This section also provides that, of the funds authorized for the Fire Research Center, not less than $5,827,000 shall be available for the Fire Research Center.

SECTION 202

This section authorizes $600,000 in excess foreign currencies for expenses of the Bureau incurred outside the United States.

SECTION 203

This section authorizes $4,121,000 in funds to be appropriated for activities in the field of innovation and productivity by the Office of Productivity, Technology and Innovation and of that amount $750,000 would be authorized to make Japanese science and technology literature available in the United States.

SECTION 204

This section provides $500,000 to conduct a comprehensive study of the extent of conversion to the metric system of weights and measures in the U.S. The study is to be completed not later than two years after the enactment of this Act.

TITLE III. ADDITIONAL PROVISIONS

SECTION 301

This section amends section 12(f) of the Organic Act (15 U.S.C., 278b(f)) to allow net income to be used to replace equipment and inventories before the net sales proceeds are paid into the general fund of the Treasury. This section also authorizes NBS to increase and retain fees for calibration services, standard reference materials and other comparable services.

SECTION 302

This section authorizes salary adjustments and provides for salary adjustments in fiscal years 1984 and 1985 to be made proportionally from line items in sections 103, 203, 101(a) and 201(a) if funds are not appropriated for salary adjustments.

SECTION 303

This section provides that funds appropriated pursuant to this Act shall remain available for expenditure and obligation according to such provisions as the appropriations act may specify.

SECTION 304

This section provides that funds may be transferred into, or out of any line item in sections 101(a) and 201(a) provided that if the Bureau wishes to transfer sums in excess of 10 percent, notification must first be given to the appropriate House and Senate Committees.

SECTION 305

This section requires the Secretary of Commerce to charge for services rendered by the Bureau to other Government agencies or in compliance with any statute unless funds are specifically appropriated for that purpose, or the costs are nominal.

SECTION 306

This section amends section 5 of the Organic Act of March 3, 1901 (15 U.S.C. 274) to provide that the Director of the Bureau be changed from a Level V to a Level IV of the Executive Schedule.

SECTION 307

This section would provide authorization for the Bureau to conduct investigations of structural failures of buildings used or occupied by the general public, and other public structures.

7. OVERSIGHT ACTIVITIES

Pursuant to Rule XI, Clause 2(1)(3)(A), and under the authority of Rule X, Clause 2(b)(1) and Clause 3(f), of the Rules of the Rules of the House of Representatives, the following statement on oversight activities is made.

Committee oversight of the National Bureau of Standards from May 1983 through March 1984 has consisted principally of hearings; inspection of the NBS facilities at Gaithersburg, Maryland, and Boulder, Colorado; staff attendance at NBS meetings and briefings; and informal discussion between Committee Members, staff and NBS representatives.

The Committee's oversight findings and recommendations are contained in the body of this report.

Hearings

Testimony was given by NBS witnesses and others appearing at NBS Fiscal Year 1984 Authorization hearings on March 22 and 23, 1983. For the NBS Fiscal Year 1985, authorization hearings were held on February 2 and 7 and March 6 and 7, 1984.

Inspection of NBS Facilities

On February 14, December 12, 1983 and January 11, 1984, Members and staff of the Committee visited the research facilities in Gaithersburg, Md. for the purpose of program and facility familiarization. Also, in January 1984, Members and staff made a site visit to the Boulder, Colorado research facilities.

Attendance at NBS Meetings

Members of the Committee and staff have met with NBS staff to receive various briefings on budget and program matters.

Plans

During the coming year the Committee plans for oversight include review of selected programs and projects of the NBS. A review of research facility utilization is currently being conducted by the General Accounting Office.

8. OVERSIGHT FINDINGS AND RECOMMENDATIONS BY THE COMMITTEE ON GOVERNMENT OPERATIONS

Pursuant to Rule X, Clause 2(b)(2) and Rule XI, Clause 2(1)(3)(D) of the Rules of the House of Representatives, the following oversight findings and recommendations made by the Committee on

Government Operations have been received: No statement of findings and recommendations was received as of the date of this report.

9. CONGRESSIONAL BUDGET ACT INFORMATION

This bill provides for new authorization rather than new budget authority and consequently the provisions of section 308(a) of the Congressional Budget Act of 1974 are not applicable. No authorization for State or local financial assistance is included in the bill.

10. COST ESTIMATE CONGRESSIONAL BUDGET OFFICE

U.S. CONGRESS,
CONGRESSIONAL BUDGET OFFICE,
Washington, D.C., March 28, 1984.

Hon. DON FUQUA,
Chairman, Committee on Science and Technology, House of Representatives, Rayburn House Office Building, Washington, D.C.

DEAR MR. CHAIRMAN: The Congressional Budget Office has prepared the attached cost estimate for H.R. 5172, the National Bureau of Standards Authorization Act for Fiscal Years 1984 and 1985.

If you wish further details on this estimate, we will be pleased to provide them.

Sincerely,

ERIC HANUSHEK
(For Rudolph G. Penner).

CONGRESSIONAL BUDGET OFFICE—COST ESTIMATE

1. Bill number: H.R. 5172.

2. Bill title: National Bureau of Standards Authorization Act for Fiscal Years 1984 and 1985

3. Bill status: As ordered reported by the House Committee on Science and Technology, March 27, 1984.

4. Bill purpose: H.R. 5172 authorizes the appropriation of $115.7 million in fiscal year 1984 and $132.8 million in fiscal year 1985, plus such additional sums as may be necessary for adjustments in salary, pay, retirement and other employee benefits in each fiscal year, for the activities of the National Bureau of Standards (NBS). In addition, the bill authorizes the appropriation of $3.6 million in 1984 and $4.1 million in 1985 for the Office of Productivity, Technology and Innovation (OPTI); $0.7 million in 1984 and $0.6 million in 1985 for expenses incurred abroad to be paid in foreign currency; and $0.5 million in 1985 for an independent study and report on the metric system. The bill would also allow NBS to adjust fees for certain goods and services to cover estimated replacement costs.

Fiscal year 1984 appropriations to date for the activities authorized by the bill are $120.0 million. The President's 1985 budget requests $130.0 million for these programs.

5. Estimated cost to the Federal Government:

[By fiscal years, in millions of dollars]

	1984	1985	1986	1987	1988
Authorization level:					
Specified (Function 370)	(1)	138.0			
Estimated (Function 920)		2.5			
Total		140.5			
Estimated outlays:					
Function 370		92.1	41.5	4.4	
Function 920		2.2	0.3		
Total		94.3	41.8	4.4	

[1] The bill authorizes the appropriation of $120.0 million in fiscal year 1984, which is the amount appropriated for 1984 in Public Law 98-166. Thus, no increase relative to the current 1984 appropriation would result from enactment of H.R. 5172.

H.R. 5172 would allow NBS to increase fees for certain reference and calibration services to recover replacement costs. NBS would be allowed to use these fees to replace inventories; any amounts collected in excess of replacement costs would be returned to the Treasury. According to NBS, additional fee collections of approximately $250,000 annually could be collected as a result of this provision, to be used for replacing inventories.

Basis of estimate: For purposes of this estimate it was assumed that the amounts authorized in the bill for 1985 would be appropriated prior to the begining of the fiscal year. In addition, pay and other benefit increases of approximately $2.5 million in 1985 were estimated based on CBO's baseline projections. Outlays reflect historical spending patterns.

6. Estimated cost to State and local governments: None.
7. Estimate comparison: None.
8. Previous CBO estimate: None.
9. Estimate prepared by: Mary Maginniss.
10. Estimate approved by:

C. G. NUCKOLS
(For James L. Blum,
Assistant Director for Budget Analysis).

11. COST AND BUDGET DATA

The bill would authorize appropriations for Fiscal Year 1984 in the amount of $119,343,000 and for Fiscal Year 1985 in the amount of $137,421,000. In addition, $700,000 in excess foreign currency is authorized for fiscal year 1984 and $600,000 for fiscal year 1985 for the expenses of NBS incurred outside the United States.

In accordance with the requirements of section 252(b) of the Legislative Reorganization Act of 1970 and pursuant to Rule XIII, Clause 7 of the Rules of the House of Representatives, the Committee estimates the costs to be incurred by the Federal Government during the current and five subsequent years for the National Bureau of Standards and related agencies as a result of the enactment of this legislation to be as follows:

Fiscal year:	
1985	$137,421,000
1986	$143,700,000
1987	$150,300,000
1988	$157,400,000
1989	$165,100,000

12. EFFECT OF LEGISLATION ON INFLATION

The anticipated inflationary impact of this legislation has been assessed in accordance with Rule XI, Clause 2(l)(4) of the Rules of the House of Represenatives. No inflationary effect on prices and costs in the national economy is expected.

Expenditures by the National Bureau of Standards are, with few exceptions, for basic and applied measurements and standards related research within the Bureau's laboratories.

These enhanced R. & D. capabilities will encourage expansion of existing links between the Bureau's scientists and laboratories and industry. This will provide for more effective transfer of innovative research findings into the industrial sector. In this manner both national industrial productivity and competitiveness will be improved.

A number of economic studies have directly and indirectly indicated that the contribution of basic and applied research and development and innovation to economic growth, increased productivity, and favorable international trade balances is high. Increased productivity and comparative advantages in international trade are generally regarded as very effective measures in combatting inflation.

While there is a time lag and a degree of uncertainty in the innovation process from the conceptualization of an idea in a research setting to the commercialization of a new product or process, the importance of R. & D. in the innovation process and its ultimate impact upon industrial productivity cannot be denied. This has been a major premise in the establishment and continued funding of the Bureau.

13. COMMITTEE RECOMMENDATION

A quorum being present, the bill was ordered reported on March 27, 1984 by a recorded vote of 26 ayes and 13 nays.

14. ADMINISTRATION VIEWS

For Fiscal Year 1985, the Administration had not, at the time of markup, provided a draft legislative proposal.

15. CHANGES IN EXISTING LAW MADE BY THE BILL AS REPORTED

In compliance with Rule XIII, clause 3 of the Rules of the House of Representatives, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new matter is printed in italic, existing law in which no change is proposed is shown in roman):

THE ACT OF MARCH 3, 1901

An Act To Establish the National Bureau of Standards

* * * * * * *

SEC. 5. That the director shall be appointed by the President, by and with the advice and consent of the Senate[.], *and shall serve at the level IV on the Executive Schedule.* He shall have the general supervision of the bureau, its equipment, and the exercise of its functions. He shall make an annual report to the Secretary of the Treasury, including an abstract of the work done during the year and a financial statement. He may issue, when necessary, bulletins for public distribution, containing such information as may be of value to the public or facilitate the bureau in the exercise of its functions.

* * * * * * *

SEC. 12. (a) The National Bureau of Standards is authorized to utilize in the performance of its functions the Working Capital Fund established by the Act of June 29, 1950 (64 Stat. 275), and additional amounts as from time to time may be required for the purposes of said fund are hereby authorized to be appropriated.

(b) The working capital of the fund shall be available for obligation and payment for any activities authorized by this Act, as amended, and for any activities for which provision is made in the appropriations which reimburse the fund.

(c) In the performance of authorized activities, the Working Capital Fund shall be available and may be reimbursed for expenses of hire of automobile, hire of consultants, and travel to meetings, to the extent that such expenses are authorized for the appropriations of the Department of Commerce.

(d) The fund may be credited with advances and reimbursements, including receipts from non-Federal sources, for services performed under the authority of section 3 of this Act.

(e) As used in this Act the term "cost" shall be construed to include directly related expenses and appropriate charges for indirect and administrative expenses.

(f) The amount of any earned net income resulting from the operation of the fund at the close of each fiscal year shall be paid into the general fund of the Treasury: *Provided,* That such earned net income may be applied [first] to restore any prior impairment of the fund, *and to ensure the availability of working capital necessary to replace equipment and inventories.*

16. MINORITY VIEWS

The Science and Technology Committee members have traditionally supported and encouraged the activities of the National Bureau of Standards (NBS). NBS has a vital role in maintaining and promoting scientific integrity at the research, development and industrial levels. The Bureau is the federal entity that can best interact between the scientific and business communities. We fully support NBS and advocate the funding necessary to enhance this vital function that NBS serves.

The fiscal year 1985 budget request puts forward several initiatives that are on the frontier of science. Clearly, the Bureau recognizes its responsibility to respond to the ever changing and increasingly sophisticated world of technology. Initiatives such as the Cold Neutron Source and the request for advanced computational capabilities reflect such advancements. Likewise, enhancements of programs in the National Measurements Labs and efforts in process and quality control measurements recognize the need to maintain a solid base program at the Bureau.

We strongly support the reauthorization of the Center for Fire Research (CFR), Center for Building Technology (CBT), and the Institute for Computer Science and Technology (ICST). We believe testimony received by the committee for four consecutive years clearly demonstrates the appropriate role of the federal government in these efforts. The Minority offered an amendment at both subcommittee and full committee that kept within the funding level of the fiscal year 1985 request, but which did support the CFR, CBT and ICST. Fiscal restraints necessitated reshuffling of requested new initiatives yet the proposal was a scientifically sound and fiscally responsible recommendation for the committee. Unfortunately, our approach was rejected by the Majority.

While we support the work of NBS, our overriding concern for the problem of mounting national budget deficits compels us to oppose this authorization. This authorization is above the budget by only a relatively small amount, but as a percentage of the total NBS budget, the increase is significant. The nation is facing a $200 billion deficit in fiscal year 1985. As a matter of principle, we cannot support this authorization which will add further to our deficit problem.

LARRY WINN, Jr.,
F. JAMES SENSENBRENNER, Jr.,
JOE SKEEN,
CLAUDINE SCHNEIDER,
HERBERT H. BATEMAN,
BOB WALKER,
WILLIAM CARNEY,
JUDD GREGG,
AL MCCANDLESS,
TOM LEWIS,
BILL LOWERY,
ROD CHANDLER.

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